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ABSTRACT

In 1987, a national roundtable was held to discuss ways in which two-year colleges can help foster productivity and economic development. This report contains the background papers used to initiate group discussions, an overview of the highlights of the roundtable, and the recommendations of participants. Following introductory comments on the roundtable, the three issue papers are provided: (1) "Preparing for Change," by Pat Choate and J. K. Linger, which examines trends in technology, trade, and demographics and their implications for education; (2) "Technical and Community Colleges: Catalysts for Technology Development," by Stuart Rosenfeld, which offers brief descriptions of regional, state, and local initiatives in technology transfer, technical assistance, brokering, research, development, testing, the creation of a high-tech learning environment, worker retraining and skills upgrading, and continuing education; and (3) "Preparing Technicians for a Competitive Work Force," by Daniel M. Hull, which advocates cooperation between community colleges and high schools to develop "2 + 2" articulated curricula and presents a training model to address the interdisciplinary skills needed by advanced-level technicians. In addition, the report provides summaries of roundtable discussions and a list of the 11 resulting recommendations. (AYC)

REPORT AND RECOMMENDATIONS

National Roundtable on Economic Development
July 16, 1987 • Nashville, Tennessee

The Role of Community, Technical, and Junior Colleges in Technical Education/Training and Economic Development

Community, Technical, and Junior Colleges
Key Partners in Economic Development
For The 21st Century

AACJC

This report has been prepared specially as a resource for The American Seminar III, Community, Technical, and Junior Colleges Key Partners in Economic Development for the 21st Century The National Roundtable, sponsored by the Keeping America Working Project and the Center for Occupational Research and Development, was funded by the Tennessee Valley Authority and The Sears-Roebuck Foundation

THE ROLE OF COMMUNITY, TECHNICAL AND JUNIOR COLLEGES IN TECHNICAL EDUCATION/TRAINING AND ECONOMIC DEVELOPMENT

A NATIONAL FORUM

Sponsored by:
The American Association of Community and Junior Colleges
and
The Center for Occupational Research and Development

Funded by:
The Tennessee Valley Authority
The Sears-Roebuck Foundation

INTRODUCTION

Two-year colleges can play a pivotal role in improving our nation's productivity. Recognizing this fact, the Tennessee Valley Authority and The Sears-Roebuck Foundation funded a national forum that was sponsored by the American Association of Community and Junior Colleges and the Center for Occupational Research and Development. The purpose of this coalition was to investigate ways in which two year colleges can help foster productivity and economic development.

Prior to the Roundtable meeting, four authors wrote three companion papers that provided a springboard to the group discussion (but did not limit discussion parameters). All four authors, Pat Choate, J.K. Linger, Stuart Rosenfeld, and Dan Hull, raised issues and concerns. Choate and Linger painted the big picture in terms of national movements, trends, and indicators. Rosenfeld focused on regional, state, and local initiatives in work force education and training. Hull's paper spotlighted the needs for a holistic model training strategy that addressed the interdisciplinary skills needed by tomorrow's technicians.

Each author offered solutions and or recommendations to some of the nation's future human resource challenges. Roundtable participants reacted to issues raised in the papers as well as other pertinent issues. The Roundtable was comprised of national leaders from government, the private sector, labor, and education Roundtable participants were encouraged to draw upon their experience and expertise as they examined critical issues and formulated solutions and recommendations.

This document contains the three papers used to spark Roundtable discussion, an overview of the Roundtable highlights, and the recommendations from the Roundtable participants. The information and ideas generated at the Roundtable will be featured at an AACJC national video teleconference on September 29, 1987 Additionally, the final report will be distributed to major economic development and education institutions throughout the nation.

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June 1987

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PREPARING FOR CHANGE

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This paper points out the need to adopt a U. S Comprehensive adjustment training strategy Vocational educators are being called upon to define a comprehensive approach that will expand training policies to encompass the needs of the entire work force—the disadvantaged and impaired worker, the new worker, the displaced worker, and all workers who will be needing lifetime skills improvement. To assist in this effort, a greater financial investment by employers is required. Choate and Linger suggest that it is time to clearly define who is responsible for training and the resources necessary to fuifill this obligation.

Executive Summary "Preparing For Change" by P. Choate and J. K. Linger

The future of the U. S. labor sector will feel the impact of (1) the accelerating influence of technology on work and jobs, (2) America's deepening involvement in the global economy, and (3) irreversible global demographic shifts. Technological change is having its most dramatic impact on the automation of production.

Foreign countries, such as Japan, Korea, Taiwan, etc., have presented a competitive challenge to the U S business, financial, educational, government and labor sectors This challenge is directly affecting the U. S worker The appropriate response to this challenge is a better educated, trained, and more productive work force.

Demographic factors involved include. (1) the post-World War II baby boom is maturing, (2) older workers are choosing early retirement, (3) the growth of the work force is slowing as the average age of workers is increasing (25-54), (4) approximately one million women per year will be added to the work force for the balance of this decade, and (5) there is a shifting distribution of younger and older workers.

Specific impacts that will be felt because of these demographic factors are (1) an increased importance on retraining and adjustment for adult workers, (2) a greater demand for worker skills to keep abreast of individual job demands, (3) the role of women in lifetime careers, (4) shortages in the military and civilian labor force due to the decline in number of young people, (5) competition between business and the armed services for entry-level workers, (6) the growing pressure for people to continue working past retirement age, and (7) necessary attitude changes and employment policies.

Older workers face several unique problems, (1) job discrimination, (2) inadequate preparation to find work or meet the challenges of new jobs, and (3) an inability to adequately handle the rejection that accompanies their plight. In addition, few employers adequately educate their executives on how to best manage workers as they move through their forties, the legal age to be considered a displaced person, their fifties, sixties, and beyond.

The keys to economic change rest with the creation of enough jobs for all who wish to work and if these people can be prepared for these jobs. If this can be accomplished, new technologies can be quickly introduced and U. S. involvement in the global economy can be expanded To accomplish this, workers must be able to secure lifetime education and training All sectors involved must be able to flexibly provide financing and creative ways to bring about this training

One place to start is with small firms and entrepreneurs. They will provide 70% of the new jobs and are noted for looking outside for their education and training needs. All workers will need "booster shots" of education and training throughout their careers. It is certain that many workers already face the prospect of occupational obsolescence and displacement Other workers can expect to change occupations three times and jobs six to seven times during their careers.

The ultimate goal should be to adopt a U S. comprehensive adjustment and training strategy Vocational educators can a isume a pivotal role in this quest by defining a comprehensive approach Training policies must expand to encompass the needs of the entire work force of (1) disadvantaged and impaired workers, (2) new workers, (3) workers needing lifetime skills improvement, and (4) displaced workers To assist in this effort, a greater financial investment by employers is required. Most of all, a clear allocation of who is responsible for training is required. Only then will the obligations and resources reside with those who are best prepared to meet this challenge.

PREPARING FOR CHANGE

The Technology Factor

The Trade Factor

The Demographic Factor

The Arithmetic of Change

Implications for Educators

Recommendations

PREPARING FOR CHANGE

Pat Choate and J. K. Linger*
TRW, Inc.

From the vantage point of the 1980s, the sweeping changes wrought by the Industrial Revolution are obvious. But even a century ago, knowledgeable Victorians were able to anticipate much of what was to come.

Jules Verne predicted submarines and trips to the moon. Edward Bellamy, the nineteenth-century futurist and author of Looking Backward 2000 – 1887, foresaw in 1886 a twentieth-century America radically transformed by credit cards, supermarkets, occupational safety, a short work week, assured pensions, early retirement, Walkman-like listening devices, free education for the masses, and women working outside the home on an equal basis with men.

Just as discerning Victorians could anticipate many of the realities of the twentieth century, so too we can foresee many of the economic, political, and social shifts that will shape people's lives in the twenty-first century. In fact, three of the most powerful forces that will shape our future are already apparent. the accelerating influence of technology on work and jobs, America's deepening involvement in the global economy, and irreversible global demographic shifts.

Individually and collectively, these are the economic, social, and political equivalents of icebergs on the move—only partially visible, yet enormously powerful and capable of altering or destroying all that lies in their path.

The convergence of these forces has far-reaching implications for business, unions and government, for financial institutions, and most important, for the people who are doing the work and the educational institutions that must prepare them for that work.

THE TECHNOLOGY FACTOR

Technology is the wild card of the future. At an accelerating pace, it is creating dazzling improvements in goods and services, generating millions of new jobs, revitalizing old industries, and spawning entirely new ones. It is rendering established products and processes obsolete, eliminating millions of existing jobs, and rapidly transforming millions of others.

*Pat Choate and J. K. Linger are authors of the new book, The High-Flex Society Shaping America's Economic Future (Alfred A Knopf, Inc , 1986), from which this article is adapted

Improvements in optical fibers, for instance, have created a communications cable that can carry ten thousand times more information than one made of copper, eliminate almost all noise, and make unnoticed monitoring virtually impossible—all at a reduced cost Advances in space-based telecommunications have also produced better, less costly service In 1965, a single satellite carried only 240 telephone circuits at a cost of $22,000 per circuit, today's satellite carries more than twelve thousand circuits at a cost of less than $800 per circuit.

Technological change is having its most dramatic impact on the automation of production. It is bringing remarkable improvements in quality and immense savings in labor costs. on average, one robot can replace six workers, and every $1 dollar invested in robots saves $3 in other production costs by improving product quality and by increasing output, material savings and flexibility.

The widespread availability of technology is also shifting competitive advantage among industries, firms and locations worldwide. When the Yamazaki Machinery Works in Japan introduced its highly automated flexible management and manufacturing system in 1983, for example, its Minokamo plant was already one of the world's most advanced machine tool factories. With less than one-tenth of the nearly 3,000 workers needed in comparable conventional facilities in the United States, the plant could turn out a compact numerically controlled lathe in two weeks, compared with three to four months for Yamazaki's foreign competitors.

Using the new super automatic system, however, the Minokamo plant can now match its previous output with only one-fifth the personnel (39 employees compared with 195 using the old system), less than half the equipment (43 pieces compared with 90), two fifths of the floor space (6,600 square meters compared with 16,500), and one-third the process time (30 days compared with 91). The new plant requires no engineering drawings, moreover, because the new production system is connected to the CAD/CAM Center at Yamazaki headquarters nearby

If American manufacturing operations are to regain their competitiveness, they too must have the cost savings, flexibility, and qualitative improvements that automation makes possible Many workers will lose their jobs in the process and require retraining for other work. At the same time, millions of other workers will require new and improved skill. to build and operate the factories of the future.

THE TRADE FACTOR

During the past 25 years, the United States has shifted from relative economic isolation to global interdependence By the mid-1980s, trade accounted for 20 percent of the U S GNP, up from 10 percent in 1960

As a result, work in America has become increasingly dependent on world trade American farmers, for instance, sell 30 percent of their grain production overseas American industry exports

more than 20 percent of its manufacturing output, and the job of one of every six manufacturing workers depends on foreign sales

At the same time, a fifth of all goods sold in the United States comes from abroad. Americans buy 36 percent of Japan's exports and 33 percent of Latin America's. They also purchase 60 percent of the manufactures that Singapore, Hong Kong, South Korea, and Taiwan export to the industrialized countries. Any significant reduction of U. S. trade would create havoc in the American economy and pitch our trading partners into economic, political and foreign-policy upheavals.

America's trade competitors are competent and sophisticated. Most have mounted aggressive efforts that represent nothing less than a new form of societal competition in which a nation's full economic resources are marshalled in the global economic sweepstakes Japan, Korea, Taiwan, Brazil, France, West Germany, and other industrial and developing nations have created national economic combines of government, business and labor. They select a few key industries which will be favored, reduce the risks of investing in these enterprises by giving them infant industry protection, and facilitate large-scale economies of research, development and production.

Virtually no national effort is spared. Promising foreign technologies are identified and secured. Basic research is cosponsored and shared A leading foreign company such as U. S Steel, Texas Instruments, General Motors, or IBM is selected as a model and economic pace horse. National cartels are formed. Generous long-term capital subsidies are provided Workers are trained and retrained, often with government subsidies. Product prices, specifications and standards are jointly determined. Aggressive export drives are launched when the industry achieves world-class competitiveness.

The U. S. Department of Commerce reports that while only 20 percent of America's goods-producing industries were subject to foreign competition two decades ago, more than 70 percent are today. American business, government and workers have failed to recognize this competitive challenge and make appropriate responses.

Consequently, one U. S. industry after another now finds itself with its back to the wall. Most of the losses are in sectors where the United States has long been dominant—manufacturing, services and high-tech goods. Foreign firms have captured more than half the U. S domestic sales of computer-controlled machine tools. Since 1960, foreign manufacturers have been able to reduce U. S world market share in auto production from 48 percent to 26 percent, in chemicals, from 66 to 35 percent, in pharmaceuticals, from 62 to 35 percent, and in metal products, from 67 to 43 percent.

For American companies and workers, the growing importance of trade and the rise of strong foreign competitors creates both problems and opportunities The problems are centered around the fact that both America's basic and its newest, most advanced and most productive industries are targeted in the 1980s and 1990s by the cooperative government-industry labor combines of other industrial nations. Thus, many American companies and jobs are at risk.

Yet deepening involvement in the world economy also offers numerous opportunities for generating new wealth, income and jobs, but only if American business can become more competitive and workers better educated and trained and more productive

THE DEMOGRAPHIC FACTOR

Although the future of work, here and abroad, remains largely unclear, much is known about a key component of the future, the demography of the work force

We know that because the post-World War II baby boom is maturing at the same time that many older workers are choosing early retirement, the growth of the American work force is slowing dramatically This means that today's workers will constitute more than 85 percent of the work force in the year 2000 Although the aging of the work force will alleviate some of the problems of youth unemployment, it will increase the importance of retraining and adjustment for adult workers. Indeed, for at least the next two decades, employers will be forced to draw primarily from today's pool of workers to fill pressing job vacancies

We also know that the average age of workers is increasing. Specifically, the portion of the population aged 25-54—considered the high productive core of the work force—is growing. This vital segment of the population, which constituted 61 percent of the work force in 1970 and 66 percent in 1984, is projected to constitute 74 percent by 1990. This unique demographic advantage creates a rare national opportunity for greater productivity, but only if the skills of American workers are kept abreast of the demands of their jobs.

Another key demographic fact that we now know is that women will be the major source of new workers in the American economy for the next ten years Almost one million additional women will enter the work force each year for the balance of this decade. Until 1995, they will comprise two of every three entrants.

Moreover, women are prepared for much more than traditional low-paying "women's work" such as retail sales or clerical jobs. Increasingly, women are as well trained for work as their male counterparts, or better trained Since the late 1970s, more women than men have enrolled in college Women are now awarded half of undergraduate degrees, and the overwhelming majority of female college graduates enter the labor force.

Equally significant, a growing number of women are rejecting traditional areas of study, such as literature, social sciences, and elementary and secondary education Instead, many are earning degrees in areas once almost totally dominated by men. Between 1970 and the mid 1980s, the portion of engineering degrees earned by women increased from less than 1 percent to almost 11 percent, the share of women medical school graduates leaped from 8 to 25 percent, and the portion of law degrees awarded to women rose from 5 to 33 percent These shifts indicate that women are deeply committed

to their careers and are likely to remain in the work force for most of their lives. This is a new reality for employers and educators alike.

Perhaps the most far-reaching co sequences of demographic change will be found in the shifting distribution of younger and older workers. The decline in the number of young people portends shortages not only in the military but in the civilian labor force as well. In fact, many businesses are sure to find themselves competing with the armed services for entry level workers, and educators will be forced to concentrate increasingly on adult education

But the aging of America will have its most dramatic—and potentially most disruptive—effects as workers retire in the early twenty-first century Already, for the first time in history, there are more Americans over sixty-five than teenagers.

As the number of young people entering the work force declines and the number of elderly Americans increases, there will be growing pressure for people to continue working once they reach retirement age. However, this will require a major reversal of attitudes and policies by employers.

The American Society for Training and Development reports that few employers adequately educate their executives on how to best manage workers as they move through their forties, fifties, sixties, and beyond

Faced with discrimination and inadequately prepared to find work or meet the challenges of new jobs, older workers are more than twice as likely as younger ones to give up searching for a job In 1984, nearly 330,000 older displaced workers had stopped looking and were no longer counted as unemployed

For these and other reasons, older workers are retiring early. While 33 percent of men aged sixty-five and over were working in 1960, only 16 percent were employed by 1984.

Almost half of these workers retire voluntarily, they are neither in failing health nor being forced out of their jobs because of mandatory age requirements. Some are retiring because of limited opportunities, others to escape dehumanizing work environments, and still others because their skills are limited or they no longer find work satisfying.

Yet the Labor Department reports that workers over forty—those legally defined as older under the Age Discrimination in Employment Act—are as productive as their younger counterparts, and even more so in most occupations. Enticing older workers to stay on the job and assuring that they are equipped with state-of-art skills is a major means to meet the nation's long-term employment needs.

THE ARITHMETIC OF CHANGE

Jobs and worker flexibility are the keys to the great economic change that is transforming work and life in the United States. If enough jobs can be created for all who wish to work and if all who wish to work can be prepared for these positions, then new technologies can be introduced quickly and U. S. involvement in the global economy can be expanded But if the nation cannot meet the challenge of job creation or cannot help workers secure the lifetime education and training they will require, trade protectionism and resistance to change are certain to escalate, regardless of long-term personal, national, or global consequences.

This turbulent economic metamorphosis, therefore, is likely to be dominated by two pivotal questions. Can the U. S. economy produce enough jobs for all Americans who wish to work? Can today's workers be prepared for tomorrow's jobs?

The answer to both questions is yes. Whether there are enough jobs depends on how many people want them and the ability of the economy to produce them. We can now see that because of the maturation of the baby boom generation, the job-creation challenge will be far less formidable in the future than it was during the past quarter century, when the U. S. economy produced more than forty million new jobs.

The Bureau of Labor Statistics, using a set of moderate assumptions, predicts that between 1984 and 1995 the American economy will create almost 16 million new jobs, enough for virtually all who wish to work.

What will be different in the future is that most of these new jobs will come from small business and entrepreneurs. In the 1950s and 1960s, big business and expanding government generated 75 percent of all new employment. But the surge of entrepreneurship, coupled with a slowdown in the growth of government, has changed this pattern. David Birch of MIT estimates that small business is now creating more than 70 percent of all new jobs.

This fundamental shift in the economy is critical to educators since large business conducts most of its own training, while small firms and entrepreneurs have traditionally looked outside their organizations when they need to educate and train their workers.

Another important consequence of these shifts in the economy is that workers face the prospect of occupational obsolescence and displacement. Workers can already expect to change occupations three times and jobs six to seven times during their careers. This high rate of occupational and job mobility will increase as the speed of change accelerates and its scope widens.

IMPLICATIONS FOR EDUCATORS

The United States faces a future in which the shift to the technologies, production processes, and management styles of the twenty-first century will proceed with few certainties and in an environment of fierce, often predatory, global competition. The most practical way to confront the challenges of rapid, uncertain, unrelenting change is to improve the nation's ability to adapt to the future, whatever it brings.

If America is to adjust successfully in the years ahead, it requires workers who can secure training, find jobs, be productive, advance and shift between jobs and occupations with ease and confidence.

Improving the flexibility of American workers requires many actions—creating personal, portable pensions; eliminating work-related discrimination, and providing safe, convenient, affordable child care services.

Equally important, virtually all workers will need "booster shots" of education and training throughout their careers. The United States requires a comprehensive adjustment and training strategy to boost the skills of its workers, preparing them for a lifetime of change in the workplace. There must be ways and means to provide remedial education and pre-entry level training for disadvantaged and impaired workers, entry-level training for more than a million new workers coming into the labor force each year, continuing training and education for the vast majority of workers who will need a lifetime of skills improvement, and retraining and adjustment assistance for the 2 million people who are displaced from their jobs each year.

Just as American educators played a pivotal role in helping the nation shift from an agricultural to an industrial economy, they now are key participants in helping American workers shift from today's to tomorrow's economy.

If education, particularly vocational educators, are to play this role, special attention is required to several pivotal issues.

The first is the need for a comprehensive approach. Today education and training programs are heavily concentrated on a small portion of the population, most of whom are young or disadvantaged. While attention to these groups is unquestionably needed, most adults and employed workers will also require additional education and training Thus, training policies must be expanded to encompass the needs of the entire American work force.

Financing is another issue In the present era of limited financial resources, greater investment by employers is required Today, public policy discourages such investment. Although there are three principal factors of production—capital, technology, and work force performance—the federal government provides incentives for investment in only capital and R&D. The lack of comparable incentives for investment in worker performance reinforces the bias of most firms

against training and retraining Investment in technology and modern machines becomes the property of the firm, while improved worker skills do not. Greater employer investment in training skills can be stimulated by either eliminating the incentives for capital and R&D or establishing comparable incentives for worker training.

Finally, a clear allocation of responsibilities is required. Today, responsibility for training is haphazardly allocated among public institutions, business, labor unions, government agencies, and private community organizations. This needs to be sorted out so that obligations—and resources—reside with those who are best prepared to meet them

In sum, America's success in meeting the challenges of swift, far-reaching, uncertain change depends primarily on how well we develop and apply the knowledge, skills, wisdom, enthusiasm, and versatility of the nation's prime resource, the American people.

RECOMMENDATIONS

1 Strengthen the customized training programs of states through. (a) new tax incentives to stimulate more private-sector donations of monies and training equipment, (b) state-owned and operated pools of training equipment that can be moved from school to school, (c) cooperative equipment-sharing arrangements with private firms, (d) incentive pay plans to encourage faculty upgrading, and (e) public training programs that are linked to identified needs of employers.

2 Create a Block Investment Credit (BIC) that would equalize federal tax treatment of investments in machinery, R&D, and worker training.

3 Create Individual Training Accounts for displaced workers—a venture-based displaced worker training program modeled on the GI Bill with self-financed, savings-and-equity-based financing analogous to the Individual Retirement Accounts (IRA).

4 Reform the unemployment insurance system so firms that give advanced notification of plant closings pay lower payroll taxes than those that close with little or no notice.

5 Reform the unemployment insurance system so tax collections are based on a company's record in contributing to unemployment

6. Release the one billion dollars of payroll taxes the federal government levies on employers to operate the state job service and use these monies to. (a) modernize testing and counseling services, and (b) computerize data exchange so the job service can better match workers seeking employment with employers seeking workers.

7. Establish local child-care information and referral services and provide federally funded child-care vouchers for low- and moderate-income families with mothers who work.

TECHNICAL AND COMMUNITY COLLEGES: CATALYSTS FOR TECHNOLOGY DEVELOPMENT

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This paper identifies the two-year college emerging as the institution best suited to bridge the gaps between theory and practice, research and commerce. Change is in order to bridge the gap—a change in the curricula and internal structure of the educational programs of two-year colleges A new mission is in order—a mission that addresses not just human resource development but economic development. Rosenfeld thinks it is time for states to re-examine the ways their schools are organized and funded to see if they have the flexibility needed to effectively serve their communities, states, and regions.

Executive Summary "Technical and Community Colleges: Catalysts for Technology Development" by Stuart A. Rosenfeld

State and local officials are beginning to comprehend the growing importance of technology, education, and information to job formation, increased productivity, and economic development. They are depending on two-year colleges to provide technical skills for the growing number of occupations that require more than the basics but less than a baccalaureate. More and more, they are depending on them for technical assistance to small businesses The two-year college is emerging as the educational institution best suited to bridge the gaps between theory and practice, research, and commerce.

Two-year colleges are aware that they must redesign their curricula and the internal structure of their educational programs to better fit anticipated changes in the workplace. By so doing, they will create a new mission that provides the economic context for high-quality technical education and addresses not just human resource development but economic development

The number of schools taking on this new mission is still quite small and the number doing it effectively is still smaller. This paper presents a legislative history of the development of two-year colleges and examines some innovative ways that they are contributing to the development, application, and use of new technologies

As far back as 1961, the vocational education system was charged with meeting both industrial and military needs. It was concluded, at that time, that advancing technology was causing many jobs to require more technical proficiency and a greater knowledge of mathematics and science Also, jobs often required a more mature person than high school age youth In 1963, postsecondary schools became unequal partners in vocational education as the elementary and secondary school education agencies retained control of the federal funds and programs The postsecondary schools' curricula became more vocational but not necessarily more technical

In the 1960s and '70s, state economic development efforts were predominantly industrial recruitment. Customized training for industry became the goal The ultimate measure of success was value to the employer, not the employee Critics called this effort a zero-sum strategy because it was based on recruiting jobs rather than creating jobs

It took a rapid contraction of labor-intensive manufacturing in the 1980s due to foreign competition to bring about changes in the structure and mission of technical colleges. Employers in emerging industries demanded higher and more flexible skills than those that could be provided in short-term, customized training.

As two-year colleges have always been the first educational institution to be called on to react to technological change, they have become more responsive to changing labor market needs than any other public educational institution. Their mission already includes economic development allowing them to focus their efforts on meeting and balancing the employment needs of the individual and the development needs of the local economy

Today the technical colleges are becoming a catalyst for economic development and growth. Their principal function is still to provide individuals with marketable skills but much of their

activity centers on the application of new technology. Community colleges and technical institutes are becoming holistic technology resource centers who educate, facilitate, and broker technology transfer They are becoming independent of other educational agencies, obtaining increasing support from economic development agencies, economic development legislation, and the private sector for their financial resources and organizational strength. They are evolving from vocationally oriented postsecondary schools to comprehensive technical resource centers.

The rapid pace of technological change and rising costs of keeping up with the latest advances in equipment and methods are causing technical colleges to become more selective about programs for which they can maintain high standards. A college has to identify its technology niches and concentrate its resources At the same time, potential and expanding businesses expect more help at each stage of the new business of the product development cycle planning, research and development, funding, marketing, and training.

This paper explains and illustrates current models being used by two-year colleges that allow them to provide a more diverse and extensive array of services for new and expanding businesses as well as continue a technology focus. Models and services discussed are. (1) technology resource centers; (2) partnerships; (3) technology transfer, (4) technical assistance, (5) brokering, (6) new business incubators, (7) research, development, and testing, and (8) high-tech learning environments.

To assist the facilitation of technology transfer, colleges are revising and revitalizing their (a) technical associate degree programs, (b) skill upgrading programs, which include but go beyond customized training; and (c) continuing education, which ranges from adult literacy to management seminars and highly technical courses for graduate engineers.

The technical associate degree program had to be revised as potential technicians can no longer acquire what they will need in twelve years of formal schooling. Skill upgrading programs were revitalized to promote technology advances and economic development. The best antidote to technical obsolescence is continuing education, and the colleges and universities, which are able to stay abreast of technological changes are best prepared to be providers. Continuing education for other faculty and instructors from other schools as well as for local businesses is a high priority of the technical colleges.

Recommendations suggested for future deliberation were. (1) states should reexamine the ways their schools are organized and funded to see if they have the flexibility needed to effectively serve their communities, states, and regions, (2) pinpoint opportunities that lie in bridging the chasms that still exist between education and economic development, particularly in rural areas that lack sophisticated technological infrastructures, (3) continue to review existing programs to be sure that the balance between the educational mission and that of the new economic development goals stays in check, (4) determine if anything can be done to encourage the passage of Part D of the Carl D Perkins Vocational Education Act of 1984 that is explicitly intended to support the kinds of technology transfer activities technical colleges are undertaking, (5) study the need for target programs for women, (6) continue to review programs for remedial training, and (7) discuss the possible need to enroll and educate the increasing number of nontraditional students. The implications for vocational education are immense. There is little doubt that technical colleges will play a larger role in technology-based development in the future.

TECHNICAL AND COMMUNITY COLLEGES: CATALYSTS FOR TECHNOLOGY DEVELOPMENT

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TECHNICAL AND COMMUNITY COLLEGES: CATALYSTS FOR TECHNOLOGY DEVELOPMENT

Stuart A. Rosenfeld
Southern Growth Policies Board

In November 1986, more than 11,600 people came to the convention center in Greenville, South Carolina, to see and discuss the most advanced manufacturing technologies. Vendors, manufacturers, college faculty, and students from Florida to California mingled about 224 exhibits that represented the latest advances in automated equipment for the factory floor, exchanging ideas, information, and business cards Ray Marshall, Lester Thurow, and Governor Dick Riley were only a few of the featured speakers. The event, **AM86: Man and Machine, The New Partnership**, was sponsored, arranged, and hosted by four of the state's technical colleges, part of their growing efforts to introduce the latest technologies to the states' industries, to make sure that there are people educated to use them effectively, and to showcase South Carolina's technology transfer capabilities. Some might be surprised to find two-year colleges putting together a program as technically sophisticated as **AM86**. Not only did **AM86** happen, even more successfully than anticipated, but equally sophisticated programs by two-year colleges to encourage technology transfer are taking shape in all parts of the country.

INTRODUCTION

A decade or more ago state economic development policy generally meant industrial parks, revenue bonds, and tax abatements. Technology was known to be important to growth but was considered outside of the purview of state government Today, however, state policies are rapidly being redesigned as economic development policy as state and local officials begin to comprehend the growing importance of technology, education, and information to job formation, increased productivity, and economic development. These officials realize that public policies can be used to facilitate technology advances and transfers, but they are still exploring their options and searching for the most promising programs.

Most new state efforts to build on technology depend in one way or another on education and educational institutions. States look to their research universities to provide scientific and technical expertise and research, to their public schools to provide youth with the knowledge and attitudes that later will allow them to produce and use technology, and to their two year colleges to provide both technical skills for the growing number of occupations that require more than the basics but less than a baccalaureate, and technical assistance to small businesses.

Each tier plays a critical role in technological growth. There are constraints, though, on just how much priority educational institutions can and ought to give to economic goals, when contrasted to their basic mission of education Further, there are structural barriers. Public high schools are unable to adapt very quickly to changes in local labor market needs caused by technology, universities are accessible to too few communities and often too removed from the needs of small businesses (although there is growing support among four-year colleges for involvement in local development) The two-year college, however, as the "new kid on the block" may be the institution least constrained and best positioned to bridge the gaps between theory and practice, research, and commerce With more flexibility in faculty hiring decisions than either high schools or universities, two-year colleges may be best able to respond quickly to changes in occupational demand and advances in technology.

Most colleges in the nation are not yet taking full advantage of their opportunities to stimulate growth And many may not wish to rearrange their priorities to include economic development. But in other places the technical college already has become both the major conduit for technological advances and the glue that binds together the various components of a comprehensive technology-based development program the research and development that leads to new products and processes, the employers who will invest in and apply the technologies, and the employees who must be able to use and understand them [1] Dr Karl Jacobs, president of Rock Valley Technical College in Illinois, has succinctly stated the newest position of the colleges.

> Community colleges can make a major contribution to the transfer of technology by bringing together area businesses and outside resources We have the infrastructure to provide the arena and the networking systems to bring people together This is especially important for smaller manufacturing operations because they cannot leverage the information on their own.[2]

The full extent to which the technical college can become an instrument for technological progress is only now emerging Across the country, technical colleges are experimenting with new and innovative programs to discover just how they can best contribute to technology-based growth

A 1986 survey of technology transfer activities at 254 institutions of higher education conducted for the Appalachian Regional Commission illustrates the extent to which technical colleges are becoming involved in technology transfer [3] Fifty-one of the 103 responses to the survey

1 To avoid confusion, two-year postsecondary institutions will be called "technical colleges" throughout the paper unless reference is made to a particular school

2 Laura Taxel, "Community colleges taking a major role in shaping region's economic renewal," **mid American Outlook**, 8 (Spring 1985).

3 Analysis of data by Louis Blair, Falls Church, Virginia, based on his report prepared for the Appalachian Regional Commission, **Strategies and Approaches for Appalachian High Educational Institutions to Diffuse Technology for Regional Economic Development,** December 1986.

were from two-year colleges The results showed not only that the two year colleges are providing a wide range of services but that they are actually providing a greater array of services than the four year colleges. For example,

- 84% of the two-year schools solve technical problems,
- 67% train managers to use technology;
- 65% have partnerships with industry to diffuse technology;
- 47% provide special assistance to entrepreneurs to use technology; and
- 43% provide some type of infrastructure support, such as incubators or innovation centers.

When asked how important technology diffusion is to their mission

- 62% believe that clearly defined roles and missions in technology diffusion are "essential",
- 55% replied that an office or center dedicated to technology diffusion is "essential", and
- 52% believe that funds to subsidize technology diffusion services to small firms are "essential."

Although there are no comparative data for an earlier time, it is safe to say that the activities mentioned are relatively new activities at technical colleges.

Technical colleges also are redesigning their curricula and internal structures of their educational programs to better fit anticipated changes in the workplace As Robert Reich asserts in his latest book, *Tales of a New America*, "To compete on the basis of rapid improvements in product and process, rather than on the basis of the scale economies of mass production, means a new emphasis on the innovative skills of workers—the productive services they deliver—and on the organizational structure of production."[4]

The reorientation of the technical college to actively encourage and support technology-based growth rather than react to change may well prove to be its most important new mission, one that provides the economic context for high quality technical education and addresses not just human resource development but also economic development. **The number of schools taking on this new mission, however, is still quite small and the number doing it effectively is still smaller.**

There are valuable lessons to be learned, which generally can be replicated elsewhere, from those colleges that have successfully integrated their new mission with their educational goals. **These lessons are particularly important to rural areas, which may have few other sources of technical nonagricultural education, expertise, and information.**

4 Robert B. Reich, **Tales of a New America** (New York: Times Books, 1987).

This paper examines innovative ways in which states' public technical colleges contribute to the development, application, and use of new technologies. There is still a great deal of "hype and hope" concerning the true effectiveness of any institutions in technology transfer, including the technical colleges. Descriptions of programs reported in this paper were impressionistic. Because they are still so new, their successes have been accepted *a priori* and their true value can only be measured over time. But even if the innovative programs yield half of what they promise, they portend to be wise investments in economic development.

THE ROAD TO UNIVERSAL POSTSECONDARY EDUCATION: THE HISTORICAL DEVELOPMENT OF THE TECHNICAL COLLEGE

The history of the two-year postsecondary school, the latest of the nation's public education institutions to reach maturity, is a story of a search for an identity. Even the name of the institutions has been a source of confusion, two-year schools are called community colleges, junior colleges, technical colleges, technical institutes, vocational-technical centers, or simply colleges.

For the first half of this century, the goal of public two-year colleges was to make community-based postsecondary education, "people's colleges," available to the large share of the youth population who were not pursuing a baccalaureate degree.[5] The first surge of growth occurred during the Depression when, for financial reasons, students had to remain nearer their homes and attend less expensive schools. Two-year colleges were both terminal institutions of higher education, providing a credential for semiprofessional or paraprofessional occupations, and transitional institutions providing an entry into baccalaureate programs for students not rich enough or not well-prepared enough to directly go to a university from high school.

Critics, however, have labeled two-year junior colleges pale imitations of four-year colleges, failing to live up to their claims of providing increased semiprofessional job opportunities for low-income students. They became a safety valve on pressures to educate lower-achieving students.[6] In 1941, 75 percent of a large sample of educators and administrators believed that the terminal function of the two-year college was much greater than its preparatory (for college) function.[7]

Sputnik, more than any other single event since World War II, piqued public interest in technology and in improving technical education, and it eventually reshaped the nation's two-year colleges. Public policy moved swiftly to alleviate the nation's shortage of technicians and Congress

5 Charles R. Monroe, **Profile of the Community College** (Washington DC: Jossey-Bass, Inc., 1972).

6 Fred L. Pincus, "The False Promises of Community Colleges: Class Conflict and Vocational Education," **Harvard Educational Review**, 50 (3, 1980).

7 David O. Levine, **The American College and the Culture of Aspirations, 1918-1940** (Ithaca: Cornell University Press, 1986).

passed the National Defense Education Act of 1957 That bill included an amendment to the federal vocational education legislation that authorized funds for area vocational centers to deliver technical education. Vocational education up until that time was a high school program, and technical education was offered either in the high school or in the growing number of proprietary programs often found advertised on bus panels, matchbook covers, and the back pages of popular magazines The two-year colleges had lobbied for federal vocational education funds and legitimacy as vocational educators since 1937 without success.

In 1961, President Kennedy convened a Panel of Consultants on Vocational Education and charged it with recommending changes in the vocational education system to better meet both industrial and military needs One of the conclusions of that Panel was that

> Because of advancing technology, many jobs require more technical proficiency and greater knowledge of mathematics and science. These jobs also often require more mature persons than youth of high school age As a result, attention is increasingly focused on postsecondary vocational and technical education.[8]

As a result of the Panel's report, new federal legislation passed in 1963, providing a **second wave** that radically altered the structure of vocational education. The result was that postsecondary schools became partners, though not equal partners, in vocational education In most states, elementary and secondary school education agencies retained control of the federal funds and programs, doling out the prescribed set asides to postsecondary schools

The law also established new occupational areas including one called Technical Occupations, which was offered almost exclusively in postsecondary institutions The postsecondary schools' curricula did become much more vocational, but not necessarily more technical In 1979, only 15 5 percent of all postsecondary students were enrolled in technical occupations and less than one in five of those was female The greatest occupational demand, however, was still for nontechnical occupations and that's where most postsecondary institutions put their resources In 1982-83, the last school year for which the U. S. Department of Education released the information collected in the Vocational Education System, only 11 percent of all postsecondary enrollments were in the technical program areas that are most explicitly technology related. Communications Technology, Computer and Information Sciences, Engineering and Related Technologies, and Science Technology Further, only eight percent of all postsecondary completers were in those four categories

As technical colleges became more vocational many of the complaints that were lodged against high school vocational education were transferred to the colleges, including the charge that postsecondary vocational education represented tracking mechanisms to "cool out" the aspirations of

8 Panel of Consultants on Vocational Education, Education for a Changing World (Washington DC. Government Printing Office, U S Department of Health, Education, and Welfare, 1963) p. 230.

lower class youth The fact that the two-year schools were postsecondary simply made the tracking seem all the more insidious Youth believed they were getting a "college" education that would open doors in the labor market, but in reality there was little to distinguish many of the postsecondary programs from high school vocational education programs, and their graduates did not fare much better in the job markets An analysis of program enrollments in southern states prepared in 1980 for the Southern Growth Policies Board[9] showed that the majority of postsecondary enrollments were in programs that are also considered high school programs—secretarial occupations, auto mechanics, and typing.

With the success of the U.S. space program and fading fear of Russian space superiority, and with automation arriving more slowly than predicted, postsecondary vocational education turned its attention to industrial growth State economic development efforts in the late 1960s and 1970s were predominantly industrial recruitment, and states, particularly in the South, began to use their two-year college systems to deliver customized training for industry

Some states, e.g , North and South Carolina and Oklahoma, began early in the 1960s to tailor programs to the specific needs of new plants These programs were short-term, explicitly aimed at facilitating economic development, and they usually led to employment. The goal of customized training, however, was to minimize industry's start-up costs, not necessarily to provide individuals with transferable and marketable technical skills The ultimate measure of success was value to the employer, not the employee The technical college became part of an industrial recruiting strategy, but one which critics called a zero-sum strategy because its goal was to recruit jobs rather than create jobs There were high quality technical programs in the nation, but they were not abundant.

It took a rapid contraction of labor-intensive manufacturing in the 1980s due to foreign competition to bring about changes in the structure and mission of technical colleges Employers in the emerging industries demanded higher and more flexible skills than those that could be provided in short-term, customized training.

Technical colleges have undergone many changes in structure, curriculum, and mission since the early part of the century. As mentioned previously, the weakness of their historical grounding, and school culture, and entrenched vested interests also are its strengths. These factors enable technical colleges to be more responsive to changing labor market needs than any other public educational institution And because the missions of the technical colleges include economic development, they can focus their efforts on meeting and balancing the employment needs of the individual and the development needs of the local economy

[9] Southern Growth Policies Board, **Setting Goals for Vocational Education**, Report prepared for Executive Committee Meeting, Atlanta, Georgia, Governor George Nigh, Oklahoma, presiding, June 1, 1984

THE THIRD WAVE: NEW ROLES IN TECHNOLOGY DEVELOPMENT

Today the technical college is entering a third phase, moving from **serving as an important but passive ingredient of economic development to becoming a catalyst for economic development and growth**. The principal function of the school is still to provide individuals with marketable skills, but schools are adding an impressive variety of new and innovative functions to revitalize businesses and expand the number of jobs. Much of this activity centers on the applications of new technology. Community colleges and technical institutes are becoming holistic technology resource centers, not only educating individuals to use and understand technology in the workplace and to make decisions regarding its use but facilitating and brokering technology transfer in ways that are as innovative as the technological advances themselves.

New Partnerships: Governance and Structure

As the purposes and functions of the technical colleges have changed, so have governance and structure. Technical colleges are becoming independent of other education agencies in more states and are obtaining increasing support from economic development agencies, economic development legislation, and the private sector for their financial resources and organizational strength. The institutions themselves are evolving from vocationally oriented postsecondary schools to comprehensive technical resource centers.

State Organizations

The organization of technical colleges at the state level varies considerably from state to state. If there is a trend, however, it is toward greater autonomy, more fiscal independence, and more collaboration among colleges.

Both policy and administrative authority in most states rest with the agencies responsible for higher education. In eight other states, however, the Board of Education or Department of Public Instruction runs the technical colleges and five states have Boards of Vocational Education or their equivalent with responsibility for two-year schools. Five states have set up independent Boards of Community Colleges to set policy for the schools, and eight states have Boards of Community Colleges to administer schools' programs.

Despite the growing recognition of these colleges' roles in technical education, they still have trouble competing for educational funds. In North Carolina between 1973 and 1983, technical college enrollment increased 89% while state per-pupil funding declined 27% in constant dollars. Half of the states in the country depend in part on local taxes to support their technical colleges, and technical colleges have been left behind in many states' education budgets. Consequently, some have had to rely on innovative funding—which may have been a blessing in disguise because it opened doors to new economic development functions. In many states, technical colleges look to departments of

economic development to support program improvements In Iowa, for instance, the Department of Economic Development established a network of Regional Satellite Centers and designated the technical colleges as those centers Most of the customized training programs and many of the new technology resource centers are funded through state economic development programs.

States with formal technology programs generally include their technical colleges In Ohio, the technical colleges are part of the state's Thomas Edison Program, and in Pennsylvania, the colleges are an integral component of the Ben Franklin Partnership Programs. Pennsylvania's four advanced technology centers collaborated with community colleges on 23 separate technology development projects in 1986-87.

Technical colleges are also increasingly willing to collaborate with each other—even across state borders—to be able to provide high quality programs or services in support of technology development. For example:

- four colleges in South Carolina jointly organized a regional automated manufacturing show, AM86;
- a consortium of four colleges conduct training under Western Pennsylvania's Advanced Technology Center,
- four different colleges in New Jersey support a sophisticated Computer Integrated Manufacturing Center; and
- ten colleges located in Iowa, Wisconsin, Illinois, Michigan, and Ohio form the Mid-America Technology Training Group, a systematic network for comprehensive technical training and information exchange

Technology Resource Centers

Technical colleges are rearranging themselves internally as well as externally, in ways that at first blush may seem inconsistent The rapid pace of technological change and rising costs of keeping up with the latest advances in equipment and methods are causing technical colleges to become more selective about programs for which they can maintain high standards To be a source of technical knowledge, expertise, and innovation, a college has to identify its technology niches and concentrate its resources At the same time, potential and expanding businesses expect more help at each stage of the new business or product development cycle. planning, research and development, funding, marketing, and training. Thus colleges must provide a more diverse and extensive array of services for new and expanding businesses at the same time that they are expected to be more focused technologically.

An increasingly popular model is the technology resource center, which operates within the structure of the technical college but may actually be administered and run as a separate operation. It draws students from outside the normal attendance area, attracts private sector dollars, is highly sought by business and industry as a source of information and applied technology, conducts applied

research and development for business, and generally provides skill upgrading as well as awarding associate degrees The centers feature state of the art equipment, maintain close ties to university research centers, have support from industry and have close links to employers, who use the facility to retrain their own employees, to train new technicians, and as a laboratory to test new processes and procedures

These technology resource centers are to the technician what the top-rate universities are to the scientist or engineer. South Carolina has taken the most systematic and comprehensive approach. The state has established eight major centers, the Robotics Resource Center at Piedmont Technical College, Advanced Machine Tool Technology Center at Greenville Technical College, a Microelectronics Resource Center at Tri-County Technical Institute, Computer Applications at York Technical College, Office Automation at Midlands Technical College; Electronic Mechanical Maintenance at Orangeburg-Calhoun Tech, Tourism at Horry-Georgetown Tech; and the Environmental Training Center (and Water Quality Institute) at Sumter Technical College While serving a local multi-county area, as the resources and reputations of the resource centers grow, they attract students from across and outside of the state

The second attribute of the technical resource center is the comprehensiveness and diversity of the services provided. Technical colleges no longer end their responsibility for economic development with education and training. Schools such as Moraine Valley Community College in Palos Hills, Illinois, and College of DuPage outside of Chicago serve as one-stop resource centers for prospective entrepreneurs and expanding businesses

The result of this new internal structure is that the technical colleges provide stronger support for local development but by specializing they also serve a much wider economic area The stronger the program, the greater the distance students will come to enroll. Of the 30 associate degree students admitted to the automated manufacturing programs at the Robotics Center at Piedmont Technical College in South Carolina last year, ten were local, ten were from the state but not the counties served by the center, and ten were from out-of-state

Partnerships

Partnerships are perhaps the most highly publicized strengths of technical colleges. Virtually all of the schools that have successfully stimulated economic development have strong ties to the private sector and to other educational institutions. The list is too long to present in this paper and the American Association of Community and Junior Colleges has an on going program called **Putting America Back to Work**, which highlights the most innovative and successful programs in the nation

One state-wide program that merits mentioning, however, is **Florida's Centers of Electronics Emphasis and Specialization**. Electronics is both one of the state's fastest growing industries and central to many of the state's other industries, such as aerospace. In 1983 the state

had more than 100,000 people employed in the electronics field, but industrial recruiters were dissatisfied enough with the quality of the electronics technicians graduating from the state's vocational programs to look out of state for technicians In response, Florida's High Technology and Industry Council and the postsecondary vocational education system collaborated to establish ten Centers of Excellence—five in community colleges and five in vocational-technical centers—that are intended not just to meet the stated needs of industry but to achieve excellence. The ten schools, which work together as a consortium under the coordination of the University of Florida, are expected to provide leadership and technical expertise to electronics education programs throughout the state and to encourage high-tech companies to locate and expand within the state.

SOMETHING OLD, SOMETHING NEW: INNOVATIVE FUNCTIONS OF TECHNICAL COLLEGES

Technical colleges are both doing new things and doing old things better They are supporting technology advances in ways that historically were not part of their missions while continuing to provide technical education and training. Their new agenda includes:

- facilitating technology transfer and providing technical assistance to entrepreneurs and existing businesses;
- operating technology business incubators;
- supporting research, development, and testing, and
- providing a learning laboratory that simulates the most technologically advanced work environment.

Old or traditional roles that are being revised and rethought, include.

- revamping the technical associate degree program in light of technological advances and new organizational styles,
- upgrading the skills of the present and new work force; and
- providing continuing education and professional development for supervisors and management.

The following are examples of some of the more innovative approaches that technical colleges are using to enhance both human resource and community economic development.

In 1985, two local people brought a concept to the technology transfer agent at the **Cuyahoga Community College** in northern Ohio. They found that fish are attracted to a hook by a luminescent chemical material—a high-tech fishing lure. The material could be inserted in any lure, but had a finite life and had to be replaced on a regular basis, creating a potentially high volume business. The technology transfer office of the college worked with the prospective business people to develop the compound they needed, to solve a contamination problem that had been plaguing them, to perfect the production process, and to put together an investment package. They used the resources of NASA, SBA, and private investors to get the business underway.

One of the most vexing problems facing American industry is the need to move new products and processes developed in the labs to the firm that can use them commercially. This technology transfer function has not been carried out very effectively in the past by any institutions or agencies Critical ingredients of a technology transfer system include an inventory of innovations, knowledge of the needs of business, and close ties to the community. The first is a technical problem that is quickly being solved with more accessible and more comprehensive databases. The second and third, however, require strong working relationships with businesses and the community.

Technical colleges have in many ways modeled themselves after the cooperative extension service, a federally supported county-level program that has served American agriculture so well for eighty years. The services that technical colleges are providing include formal networks of technology transfer agents who (a) maintain or have access to databases of technical information, (b) provide technical assistance on request, particularly to small businesses, and (c) broker agreements among agencies to solve technical problems.

Technology Transfer

South Carolina's State Board of Technical and Comprehensive Education (TCE) has made technology transfer one of its top priorities. According to a working document from the Board, "The reason community colleges have not assumed this role (technology transfer) has been their perception of their role in education." Taking on the responsibility for technology transfer would "expand our role to education in the broadest sense as purveyors of information, skills, knowledge, and techniques." The state uses the technical colleges to market the services of the Southern Technology Application Center (STAC) out of the University of Florida. The system contains over 1250 computerized databases, access to the Federal Laboratory Consortium and to NASA's field centers, and to consulting services through the University of Florida system

The state of Ohio also turned technology transfer into a statewide service by creating the **Ohio Technology Transfer Organization** (OTTO). Technology transfer agents are assigned to 28 sites, including 24 technical colleges In 1986, 32 OTTO agents working in the two-year schools helped start 118 new businesses and assisted 935 businesses in bringing new products to the market. Approximately 70 percent of the program's clients last year were businesses of fewer than 20 employees, 32 percent are manufacturing businesses, and 31 percent of the requests are for engineering or scientific assistance.

Virginia's Center for Innovative Technology is establishing a Technology Transfer Agent Pilot Program, funded by the General Assembly, in eight technical colleges The program objective is to deliver "specific technology transfer services to local business and industry by selected community colleges that contribute significantly to the economic stability and growth of the local area." The sites were selected on the basis of the concentration of businesses with advanced technologies or mature industries that could benefit from technological innovations, lack of access to a research university, and the college's commitment to exploring new and innovative roles

Technical Assistance

The technical college, which is the main source of technical expertise in many communities, is frequently called on for technical assistance by local planners and local business people. Last year, for example, South Carolina's eight technology resource centers responded to 351 requests for assistance from business and industry and 190 requests from other technical colleges, **The Fox Valley Technical Institute** in Appleton, Wisconsin, had 684 contracts with business last year and 25 percent of them were for direct technical assistance **Cuyahoga Community College** in Ohio handled 4,139 different requests from 2,790 companies in 1985.

One model for providing technical assistance through the technical college is the small business development center (SBDC) Though not limited to working with technology dependent businesses, many of the most promising clients do use or market new technologies. The state of North Carolina has set up SBDCs in 35 of its 58 community colleges and allocated $50,000 to each to provide for a director The SBDC at **Guilford Technical and Community College** is an example of the extent to which the colleges can encourage and support new business start-ups The center has provided assistance to a high tech manufacturer of aircraft blades, a word processing business, a programming service business, a firm that manufactures electronics boards to enhance x-rays, and a firm that builds electronic autoclaves used in medicine Services include developing business plans, linking business people to Small Business Innovation Research grants, export marketing firms, and sales representatives, training employees, and providing workshops for the business owners

Brokering

The state of Illinois is trying a technical assistance model with a somewhat different emphasis at a small number of its colleges. These colleges are primarily brokers of services in addition to providing education and training. The **Technology Commercialization Center** works with the prospective business to identify its needs and then bring management together with those who can provide the services, either inside or outside of the school. Although most of the centers are in universities or federal laboratories, the state has funded two in technical colleges. The center at the **College of DuPage** in Glen Ellyn provides one-stop technical assistance for technology related businesses that includes research assistance, feasibility studies, prototype development and product testing, patent applications, technical education, identifications of funding sources, and marketing assistance. By the end of January 1987, the new Center had served 17 clients, including developing six prototypes, applying for two patents, and working with six businesses in the early stages of an invention. One of the college's successes was a company that developed a technically advanced rewinding system for rappelling equipment used in mountain climbing. The College linked the potential business with the small business development center, research labs at the university to perfect the mechanism, and sources of funding to get the business off the ground.

The New Business Incubator

Three years ago the Fantus Company, after analyzing the economy of Wausau, Wisconsin, concluded that one of the area's major untapped economic assets was a two-year associate degree program in Laser Technology at the **North Central Technical Institute**. That technology, the company reported, could prove a valuable resource to new businesses if offered in conjunction with a supportive environment. The Institute, the city, the county economic development councils, the area regional planning office, the chamber of commerce, and a number of local businesses began plans to convert a vacant industrial building into an incubator for businesses that could use or benefit from laser technology. In spring of 1987 the incubator received a $775,000 grant from EDA to supplement the funds raised locally and the incubator was off the ground. Students from the laser technology programs and the small business management program will work with the new businesses wherever appropriate.

North Central Technical Institute is an example of a technical college working with the community for local development. The school modified an innovative and still experimental policy, the business incubator, to fit the structure of the technical college. A new business incubator provides a protective environment in which a new or expanding business can establish itself in the market at minimum expense, receive technical assistance, and in the case of new technologies, work out some of

the bugs before going into full production. It is one of the latest programs created to respond to the realization that small businesses, not large corporations, are the nation's largest source of new jobs

The **Noble Center for Advancing Technology** at Oklahoma State University's Technical Branch has developed a similar specialized incubator around technology in waterjet cutting, a computer positioned, abrasive, high-pressure stream of water Though not limited to that particular technology, the Center is trying to use the new technology to solve special needs of industry for cutting hard materials with minimal distortion. It is, for example, experimenting with the technology on various materials for several corporations, including evaluating the use of waterjet cutting to bore high tolerance holes for GM's Saturn plant.

The advantage of locating the incubator within a technical college, particularly for high-tech businesses, is that businesses have access to faculty trained to work with small businesses and familiar with new technologies, to advanced equipment, and to a technically trained work force It gives the students the exposure to the problems associated with technological change, new business start-ups, and provides opportunities for future employment. And it serves the community by supporting budding entrepreneurs or existing businesses that are embarking on expansions.

A number of other technical colleges have set up incubators in recent years **Des Moines Area Community College** in Iowa created the "Golden Circle Incubator" as a not-for-profit company for new or expanding businesses. The incubator is one of three in the state but the only one at a technical college: the other two are at state universities. Monthly overhead expenses for businesses in the incubator are less than half of what they would be in the private sector, and businesses are eligible to remain in the incubator for up to two years. The incubator gives priority to the most innovative applicants and two of three manufacturing businesses currently in the facility are what the director calls high-tech businesses

Niagara County Community College in Niagara, New York, also has opened a new incubator Its first client will produce a circuit board once manufactured by a large corporation but recently discontinued The company, started by one of the corporation's engineers, will combine the expertise of a Canadian company and an American company in Ohio to produce the board and market it both to the corporation that once produced it but still needs it, and to others The firm will use the electronics laboratories of the school for its R&D, the incubator as its plant, and students as staff to help develop a prototype of the production process. The Technical Assistance Center of the school, which has special state funding, will help the fledgling company find funding and markets

Rarely is an incubator an isolated activity within a college, those that provide incubators nearly always do it in combination with a broad range of services. The **Des Moines Area Community College**, for example, also provides consulting to businesses, a quality of work life institute, a computer literacy institute, a conference center, as well as technical training, the incubator in Wausau is part of the college's Technological Innovation Center, which provides an array of services to local businesses, and the incubator in Niagara is under its Technical Assistance Center

Research, Development, and Testing

In 1984, **Southwestern College** in Chula Vista, California, entered into an agreement with San Diego Gas and Electric Utility to serve as a test site for solar heating and a photo voltaic cells power supply. Students assembled, installed, and maintained the experimental units and recorded and analyzed data They discovered, among other things, that one solar panel was more efficient than two.

Nothing demonstrates the new scientific sophistication of the technical colleges and their students more than the willingness of industry to enter into agreements with two year colleges to experiment and test new processes and products At the same time that colleges contribute directly to technological advances, students learn first hand how to tackle technical problems and how to use their skills and knowledge in innovative ways The research generally responds directly to the practical problems associated with new or different production methods

Southwestern College's agreement with San Diego Gas & Electric to experiment with a new product is not an isolated example Students at a ceramics technology program at **Hocking Tech** in Ohio test and evaluate material submitted by industry on $500,000 worth of advanced equipment donated by industry. At the **Fox Valley Technical Institute** in Appleton, Wisconsin, Miller Electric has an on going arrangement with the automated manufacturing program to try out new processes, test equipment, and work on special projects For this, the company has provided equipment

The **Noble Center for Advancing Technology at Oklahoma State University, Technical Branch** in Okmulgee, Oklahoma, opened the doors of its multi million dollar facility in 1985 As the reputation of its programs and resources spread, businesses increasingly looked to the Center for assistance Recently one of a small number of companies that "re-manufactures" automotive parts asked the Center for help in solving some of the technical problems associated with rebuilding computerized automobile components The school will work with the firm to design a prototype testing procedure and develop standards In addition, the Center is using its waterjet cutting technology for experiments with a number of clients, including General Dynamics, General Motors, and the U.S. Navy.

Moraine Valley Community College in Palos Hills, Illinois, has a slightly different arrangement for contributing to industrial research. Rather than provide the R&D at the school, they link businesses that have technical problems to the scientific expertise of the Argonne National Laboratories. The school helps businesses establish cooperative R&D arrangements, get inventions or patents evaluated, and it provides consulting services to small businesses

High-Tech Learning Environment

In March 1984, **Chattanooga State Technical College** in Tennessee dedicated what was then believed to be the most sophisticated automation training center in any two-year college The three million dollar Center for Productivity, Innovation, and Technology housed advanced equipment that included flexible manufacturing cells, robots, CAD/CAM, and automated quality control units. The investment was expected to both revitalize local businesses and attract businesses that need help in staying on the cutting edge of new technologies. The Center's three-pronged mission, according to its director, is to educate associate degree students in state-of-the-art technology, retrain workers whose skills are being made obsolete by technology, and provide a laboratory for industry to help them solve technological problems

Applied laboratories that simulate advanced technical workplaces are proving to be invaluable to technical education and to the technologically advanced manufacturer This environment, once prohibitively costly, now is affordable because the private sector and the state increasingly recognize its value as an investment. Nearly every state-of-the-art college laboratory has equipment or funds for the purchase of equipment donated by the private sector and some special funding from state legislatures. In return, the school may provide the company with access to the facility for development and training and provide the state with jobs. Each of the eight centers in South Carolina described earlier has a technologically advanced lab that simulates an advanced workplace but is designed for learning.

The **Camden County College** in New Jersey, with support from the state's Jobs, Science, and Technology Bond Act of 1984, is constructing a $4 3 million facility to house an advanced Computer Integrated Manufacturing (CIM) program The three objectives of the center, according to director John D'Alessandro, are to educate a technical work force, conduct research on industries' needs for advanced manufacturing, and provide non credit continuing education to upgrade manufacturing skills When complete, the facility will include six automated manufacturing centers and serve six technical colleges in the state Students can pursue technical associate degrees by taking the first year of courses in their home schools and taking the second year at the Camden County College

As the centers begin to pay off, states become more willing to invest The state of Ohio provided $5 4 million for the construction and equipment of an Advanced Technologies Center at the **Lorain County Community College** outside of Cleveland It is intended to provide an advanced training facility, serve as a technology transfer center, and provide a library of technical information Industry already is taking advantage of the facility and providing equipment. Cincinnati Milacron, one of the nation's largest producers of industrial robots, uses the Center to demonstrate its products to customers, while at the same time training students.

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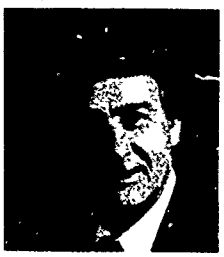

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WRITERS

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TRADITIONAL MISSIONS AND NONTRADITIONAL METHODS

As the colleges act to facilitate technology transfer, they provide a source of and environment for educational opportunities that improve the technical education of the students Colleges have revised and revitalized their (a) technical associate degree programs, (b) skill upgrading programs, which include but go beyond customized training, and (c) continuing education, which ranges from adult literacy to management seminars and highly technical courses for graduate engineers

Educating the Renaissance Technician

At the Robotics Center at **Piedmont Technical College in South Carolina**, students in the Automated Manufacturing Program take courses in Sensor and Systems Interface, Workcell Design, Robotics System Operation, and Numerical Control Manufacturing in addition to the more basic courses in scientific and mathematical concepts. The latter must include at least one unit of calculus, two of algebra and geometry, three of physics or chemistry, and writing and communications The program was designed on the assumption that the industrial workplace is changing and that individuals need strong communications and problem solving skills and must be prepared for interdisciplinary work, all of which require stronger fundamental skills.

One of the major forces driving changes in the technical colleges is the demand for technically trained workers who have not only the skills to use new equipment but the ability to understand the equipment and its place in the total manufacturing operation They must be able to respond swiftly and independently to the inevitable problems that occur whenever programmed technologies replace craft and experience With modern technology and management methods and more fully integrated production systems, business relies more on its nonprofessional staff than ever before

This is a departure from the past when the title, *technician*, implied a high level of specialization. Modern businesses seek the individual who, in addition to technical competence, is able to understand how the entire production and business systems fit together, can tackle complex technical, systemic, and interpersonal problems, can contribute to more effective use of new technology, and is able to adapt to change In other words, businesses that depend on technology want the modern equivalent of the **Renaissance Man or Woman** [10] Unlike the Renaissance Man of

[10] Stuart A Rosenfeld, "The Education of the Renaissance Technician Postsecondary Vocational Technical Education in the South," **Foresight 4**, (Fall, 1986), Research Triangle Park Southern Growth Policies Board

the fifteenth and sixteenth centuries who *could* acquire a wide range of skills and diverse knowledge because the world was *simpler*, the Renaissance Technician of today and tomorrow *must* acquire broader-based skills and knowledge because the world is more *complex* and changing more quickly To the original Renaissance Man, diversity and adaptability were luxuries, to the Renaissance Technician they are necessities, critical to the modernization of the economy

The implications for vocational education are immense. Potential technicians can no longer acquire what they will need in just twelve years of formal schooling As high schools concentrate more on providing the fundamentals needed just to become technically competent, the technical colleges will have to complete the education of the Renaissance Technician

The best way to do that is by providing a less specialized curriculum in an environment that challenges the ingenuity and problem-solving ability of the student. A number of technical colleges are revamping their programs to provide just those opportunities for students. A recent proposal for curriculum reform submitted by the **Technical Branch of Oklahoma State University** at Okmulgee states.

> To assure meaningful employment opportunity and to insure against early occupational obsolescence graduates from all technical programs need to possess a broader understanding of the applied sciences and technologies relating to their specialization At the very least, they need an awareness that assures an understanding of the concepts, technical vernacular, and relationship (past and potential) to their technology And these graduates while students must have been challenged to listen, read, interpret, analyze, synthesize, and communicate their findings and conclusions in logical, meaningful terms Ideally, they will also possess a business-economic acumen and "people skills" to enhance their success as supervisors, and in managerial positions [11]

One of the consequences of increased skill and knowledge requirements of the workplace is improved coordination with both lower and higher educational institutions. The term "2 + 2," which refers to a program in which the last two years of high school are designed to prepare students for two-year associate degree programs, is becoming more popular and more common But the natural extension, the "2 + 2 + 2," with the technical college curriculum articulated with a bachelor's degree program is now beginning to gain some support **Williamsport Area Community College** in Pennsylvania has such an agreement with Rochester Institute of Technology giving students the option of transferring into a four-year program after receiving an associate degree **Southwestern College** has a similar arrangement with San Diego State University in California, and Oklahoma State's Technical Branch is recommending the same

[11] Oklahoma State University Technical Branch, **Proposal for Curriculum Reform**, February 16, 1987

Retraining and Upgrading Skills

As automation transforms manufacturing in the South, more and more of the workers will be required to understand the microprocessors that control the equipment. The **Applied Microelectronics Center for Innovation at Tri-County Technical College** in Pendleton, South Carolina, offers short courses on programmable controllers, essential to automated industries, to upgrade the abilities of industry technicians and engineers enough to program equipment and to be able to solve system problems that occur. Courses are both customized to the needs of specific clients such as Michelin and General Electric, at much lower costs than they would incur if conducted internally, and are offered to the general public as well. About 200 people will go through the 25-30 different 22 1/2 hour programs this year.

With all of the new and innovative things technical colleges are doing to promote technology advances and economic development, customized training remains the bread and butter of many schools. Technical colleges still exist in part to serve the training needs of new and expanding businesses, a relic of economic development incentives rooted in the past but still very much alive and at times very successful. Where the occupations require technical skills, however, the technical capacity and capabilities of the program and staff take on added importance.

Skill upgrading, even when company-specific, however, is not quite the same as traditional customized training. Although most skill upgrading is a joint venture with industry, courses are intended to improve the skills of the individual rather than acclimate him or her to a particular firm's style. **Skill upgrading of displaced workers may require beginning with basic skills, which means that technical colleges must have the capacity to provide adult basic education prior to any technical education.**

Digital Equipment Corporation worked with **Southwestern College** in Chula Vista, California, to set up a minicomputer training program. The state eventually matched the value of Digital's donated equipment with a grant of $135,000. The Biomedical Equipment Technology Program at **Stanly Technical College** in Albemarle, North Carolina, operates a program for SunHealth, a leading hospital engineering firm.

The large influx of foreign owned companies in the South also is beginning to affect the education offered in the colleges. **Durham Technical and Community College** in Durham, North Carolina, trains skilled workers for industries in the Research Triangle Park area, including General Electric and Mitsubishi. With a growing number of Japanese companies moving into the area, the school has had to add courses in Japanese history, culture, and management style.

Continuing Education

The **Lintner Center at Portland Community College** in Oregon was dedicated in 1985 to provide advanced education to the state's technical industries It represents a collaborative arrangement with the state's universities and high-tech businesses The center provides a convenient site for continuing education—all the way through graduate programs—to employees of high tech business It acts as broker for educational services that are provided by the state's public and private universities

Technological change and continuing education are inseparable and critically important to a growing economy The best antidote to technical obsolescence is continuing education, and the colleges and universities, which are able to stay abreast of technological changes, are best prepared to be providers Continuing education for other faculty and instructors from other schools as well as for local businesses is a high priority of the technical colleges The Technology Resource Centers in South Carolina ran 164 programs for faculty and staff of the state's technical schools between July 1985 and July 1986

The advantage that technical colleges have over universities, which also have continuing education programs, is that they are within commuting distance of most businesses Many technical colleges, however, attempt to provide the best of both worlds—the expertise of the universities and the proximity of the college—by using technical experts from the universities to conduct courses in person and over telecommunications networks

Some technical colleges are able to provide both on-site courses and conferences and interactive telecommunications The **D. J. Bordini Technical Innovation Center** in Appleton, Wisconsin, conducts professional seminars and conferences that can accommodate 225 persons and has a full multimedia center with satellite teleconferencing capabilities. The school has just begun operating TechNET television, which brings live interactive training to businesses in the state on a regular, 35 hour per week, basis

COMMENTARY

Most new initiatives of technical colleges for promoting technology development are in their early stages The schools are still testing the waters to see what they can do well and how extensive a role they can and should play in local development Their greatest opportunities lie in bridging the chasms that still exist between education and economic development, particularly in rural areas that lack sophisticated technological infrastructure Many of the colleges that have taken initiatives to

spur technology development have become major sources of technology and expertise But they face a number of challenges as well.

Despite rapid growth in enrollments and expansion of activities, funding has been a problem The federal government has not yet discovered the economic value of the technical colleges and federal funds still go predominantly to the high schools in most states. The fact that until 1984 federal legislation had to include a 15% set aside for postsecondary institutions attests to their second-class citizen status. In 1984, new vocational education legislation was enacted that eliminated that set aside and added a set aside for retraining of adults Yet the last time the government released data, postsecondary schools received little more than the targeted amount in many states. Part D of the Carl D Perkins Vocational Education Act of 1984, Industry-Education Partnerships for Training in High-Technology Occupations, which is explicitly intended to support the kinds of technology transfer activities technical colleges are undertaking, has yet to be funded. States and schools that are willing to invest in their technical colleges are finding that compared to other levels of education, the payoffs are quick and measurable

Even though the technical colleges had their start serving students without the wherewithal to attend four-year schools, enrollments of minorities and women remain low in technical programs There are few examples of programs that are targeted to women, such as Women in Technology at Durham Tech in North Carolina.[12] Most special efforts are highly dependent on federal funds, and as federal funding diminishes, the programs tend to disappear The projected decline of high school graduates and increasing proportion of minority students suggest future skill shortages. Technical colleges may soon find that they have to make greater efforts to enroll and educate nontraditional students to meet the demand In addition, two-year colleges have to devote more resources to adult basic education for those displaced workers lacking the basic skills to be retrained for technical work The U S Department of Labor estimates that three-fourths of all displaced workers need basic education prior to retraining

Another challenge that technical colleges may face is ensuring that strong support of economic development does not displace their educational missions The balance between educational and economic development goals, or between meeting the needs of the individual and the economy, is tenuous There will undoubtedly be critics of the new roles of technical colleges if they do not retain a liberal arts curriculum, even in vocational institutions, and an academic environment that supports free inquiry Although economic development is a more prominent goal in the two-year college than in any other educational institution, it must remain subordinate to the intellectual development of the individual

[12] Stuart A Rosenfeld, "Expanding Options for Women in the Southern Work Force," Foresight 2 (July, 1984).

There is little doubt that technical colleges will play a larger role in technology based development in the future and that they will continue to learn from successes as well as failures Based on what is known thus far, the full technology development potential of the technical colleges has not been approached and most programs are still in the embryo stage States ought to re examine the ways their colleges are organized, governed, and funded to see if they have the flexibility and resources they need to effectively serve their students, communities, states, and regions

RECOMMENDATIONS

- Each two-year college ought to meet with local or area economic development agencies, chamber of commerce, and civic and labor organizations to **reassess its mission** and establish the extent to which it wants to be involved in economic development

- Each two-year college that wants to play a larger role in economic development ought to **prepare a long-range plan** for how it can best achieve its goals, including what resources it will require, how it will balance its liberal arts programs with its occupational programs, and how it will respond to the needs of those segments of the population that have not fully benefited from technical programs in the past.

- States ought to recognize the unique features, needs, and contributions of two year colleges and **develop appropriate legislation** that combines educational and economic development goals.

- Each state should **examine its budgets** to see if allocations to two year colleges have kept pace with increases in enrollments and with expanded responsibilities

- State agencies responsible for two year colleges ought to be included along with the boards of higher education in all **technology development programs**.

- States ought to **evaluate 2 + 2 + 2 programs**, looking at how the last two years of high school, two-year programs, and bachelor degree programs can be linked to provide both employment and further educational opportunities for youth.

- With increasing basic skills needs, two year colleges ought to **coordinate adult basic education** as well as technical education Though not necessarily the most effective delivery system for adult education, the college system could coordinate, administer, and fund state-wide programs to seek out adults who lack skills for technical work

- Selected two year colleges should **establish demonstration laboratories for businesses to become acquainted with and experiment with the latest manufacturing technologies**, much as the vocational technical colleges of West Germany do The two year colleges could do for industry what demonstration farms once did for farming

RESOURCES

Thanks to the following people for supplying information for this report
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PREPARING TECHNICIANS FOR A COMPETITIVE WORKFORCE

Daniel M. Hull, President
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Waco, Texas

This paper focuses on the role of the advanced level technicians as a key factor to higher productivity and quality. Hull implies that most of our public institutions are inadequately prepared to educate/train and retrain these new technicians. He describes a model training strategy and encourages two-year colleges to cooperate with high schools in a "two-plus-two" articulated curriculum Hull tells us of the "Retraining for Technology" model being implemented in Tennessee. Most of all, Hull reemphasizes what Choate and Linger point out and Rosenfeld confirms. the competitiveness of America depends on the availability of a well trained work force who depend on an effective, multifaceted, educational system.

Executive Summary "Preparing Technicians For a Competitive Work Force" by Daniel M. Hull

The competitiveness of America depends on the availability of a well-trained work force who depend on an effective, multifaceted, educational system. To understand what the role of secondary and postsecondary schools should be in their support of industry, we must (1) identify the abilities needed in technical workers, (2) examine how technicians are prepared and updated by formal or informal training; and (3) make recommendations that ensure the optimum use of our educational system.

U. S. workers are not being properly prepared for the competitive challenges of a world economy. Educational forces must help industry develop and maintain a competitive edge. We must restructure our work force to be (1) diversified, (2) focused on quality, (3) problem-solvers, (4) productive; (5) responsive to change; and (6) retrainable.

Currently, a production team is composed of (1) assemblers who are being replaced by robots or workers from developing countries, (2) craftspersons who are being replaced by computer-controlled machines, (3) operators whose need is increasing, and (4) technicians who will fill the void between engineers and other production workers and machines.

The role of public education in preparing these groups should be reexamined Public education and training institutions should deemphasize or eliminate training for assemblers or operators. Craft training should be evaluated frequently to determine the supply-and-demand ratio. If a need is valid, students should be taught basic scientific principles, as well as tools and procedures.

It is the training role for the new technician that requires the most scrutiny. We know technicians are needed to build, modify, install, maintain, repair, and calibrate today's new, complex equipment in fields such as, (1) manufacturing plants, (2) processing plants, (3) hospitals/clinics, (4) communication systems, (5) power-generating plants, (6) modern buildings, and (7) automobiles/ transportation. We have identified nine tasks that we know technicians must be trained to perform. We also know that most of our public institutions are inadequately prepared to educate and train the numbers or the quality of technicians needs.

Recommendations to solve these problems include. (1) technical education and training should be focused at the two-year postsecondary level, (2) technician education/training curricula should be restructured with statewide models developed, tested, and required, (3) high school students should be counselled and persuaded to begin preparation for technician education/training in the eleventh grade through 2+2 articulated curricula, (4) postsecondary institutions should test students and place those who need it in remedial "tech-prep" curricula, (5) training programs designed to train displaced workers should use adapted versions of the "Retraining for Technology" model, (6) short-term retraining/upgrading courses should be offered by technical institutions, and (6) a cooperative, statewide, computerized network for sharing curriculum and teacher resources should be established.

PREPARING TECHNICIANS FOR A COMPETITIVE WORKFORCE

Introduction

The Production Team
- Assemblers
- Craftspersons
- Operators
- Technicians

The Role of Public Education in Training the ProductionTeam
- Training Assemblers and Operators
- Training Craftspersons
- Training Technicians

Technician Training Programs
- Characteristics Employers Want in Technicians
- Curriculum Changes Needed

The Core Curriculum. An Efficient and Cost-Effective Approach

How Students Enter Technician Training Programs
- High School Students and Adults Seeking Career Changes
- Retraining Displaced Workers for Technology

The Need for Cooperative Networks

Recommendations

PREPARING TECHNICIANS FOR A COMPETITIVE WORKFORCE

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INTRODUCTION

Economic health in a world market requires that business and industry develop and maintain a competitive edge Succinctly stated, this means that desirable products and services must be developed and delivered at attractive prices. Thanks to the ingenuity of scientists, engineers, and other specialists, the U.S generates an abundance of ideas for and about new products, we lead the world in the number of new inventions each year. The people who think up and design new products, however, are not the ones who make them in mass quantities. This task falls to another group of people: the production team.

If members of the production team do their jobs well, sound management and marketing practices may parlay the products into national and international successes. If the production team does its job poorly, they probably turn out products that are overpriced or that under-perform—or maybe both Consumers, who are becoming increasingly discriminating, are likely to reject what they are offered, and competitiveness becomes a goal still to be achieved rather than a milestone of success.

Since the nation's production teams play a critical role in determining the degree to which competitiveness is realized, they are an important consideration in national planning for economic development. Their training and education, therefore, are national concerns.

Who are these people who make up production teams? What do they do? How are they trained? How can their performance be improved? Above all, what training and education issues does this group raise, and how are these issues addressed? These are the questions that this paper explores, with a particular emphasis upon one group of the production team. the technicians. They, among all workers, are most able to leverage the talent and knowledge of scientists, engineers, designers, and business strategists for they combine a knowledge of technical principles with hands-on skills How we manage our educational resources to meet their training needs is a matter of utmost importance.

THE PRODUCTION TEAM

Products are produced by a team made up of four groups. assemblers, craftspersons, operators, and technicians

Assemblers are unskilled or semiskilled workers who are usually engaged in routine tasks that require little training In many cases, assembly work now is done by robots Where manual labor still is required, employers look to workers from developing countries, at much lower wages. Examples of such employers include manufacturers of shoes, clothing, furniture and electronic equipment Assemblers are very susceptible to becoming displaced workers.

Craftspersons are highly skilled workers, trained in the use of tools and techniques for specific processes and operations Craftspersons include machinists, drafters, welders, electricians and carpenters When an industry changes tools or techniques, its craftspersons may become obsolete and require retraining The need for craftspersons is declining in areas where computer controlled machines and processes are becoming more widely used

Operators provide the man-machine interface for tasks like word processing, laser cutting, electric power generation, truck driving, and robotics Operators interpret manuals and specifications to make a machine work properly. Generally speaking, they work with devices such as buttons, knobs, and displays on the "outside" of the equipment. When necessary, they make "external adjustments " In some fields, the need for operators is increasing

Technicians, the fourth group on the production team, are the most critically important members In the broadest sense of the word, a technician may be thought of as a paraprofessional who is educated and trained to extend the thoughts and hands of a professional in any one of a variety of fields such as medicine, law, accounting, and engineering The focus here, however, is on engineering technicians—those technicians who build, modify, install, maintain, repair and calibrate today's complex new equipment that is found in places as diverse as manufacturing plants, intelligent buildings, communication systems, hospitals, and power-generating plants Some technicians are production workers and some are service workers.

In contrast to the operator, who works on the "outside" of equipment, the technician works on the "inside" of the equipment, where gears, computer chips, motors, fiber optics, hydraulic actuators, lasers, ultrasonic sensors and vision systems are found To build, install, operate, and keep equipment working efficiently, technicians must know about all the different devices of a machine and how they work together. The types of tasks that technicians perform are shown in Table 1

To be competitive in the world economy, production teams are needed that may be characterized as—

* Diversified
* Focused on quality
* Oriented toward problem-solving
* Productive
* Responsive to change
* Retrainable

Table 1. Tasks Performed by Engineering Technicians

- Perform tests of mechanical, optical, hydraulic, pneumatic, electrical, thermal and electronic/digital components or systems, prepare appropriate technical reports covering the tests.
- Obtain, select, compile and use technical information from computer-controlled measuring, recording and display instruments
- Use computers to analyze and interpret information
- Prepare or interpret engineering drawings and sketches Write reports, working procedures and detailed specifications of equipment
- Design, help develop, or modify products, techniques, and applications in laboratory and industrial settings
- Plan, supervise or assist in the installation and inspection of complex technical apparatus, computer equipment, and control systems
- Operate, maintain and repair apparatus and equipment with computer-controlled systems
- Advise, plan and estimate costs as field representatives of manufacturers or distributors of technical apparatus, equipment, services and/or products
- Apply knowledge of science and mathematics to data analyses while providing direct technical assistance to scientists or engineers engaged in research, experimentation and design.

All members of the production team must be trained to focus on quality and to be productive It falls more to technicians than to other groups, however, to be diversified, oriented toward problem solving, and responsive to change Also, technicians are more retrainable than other groups on the production team.

THE ROLE OF PUBLIC EDUCATION IN TRAINING THE PRODUCTION TEAM

Each group within the production team requires training. The support of public education in providing this training, however, should not be equal for all groups

Training Assemblers and Operators

The role of public educational institutions in preemployment training of assemblers and most operators should be limited or nonexistent Since 1981, hundreds of public institutions developed programs for training robot operators This is an example of a costly mistake Since the training period is relatively short and the training content is specific to a company's equipment/process, the

training provided by the employer is effective and adequate Many of the jobs for assemblers and operators will likely be filled by dislocated workers.

Training Craftspersons

Craft training for youth and adults has been and probably will continue to be conducted in secondary and postsecondary vocational programs But craft training programs are changing, and increasingly they are coming under scrutiny There's a growing recognition that students should learn **why**, as well as **how**, something works, that they should know the principles as well as the tools and procedures of their jobs So equipped, they become potential problem-solvers and, therefore, more valuable workers In addition, they are more easily retrained when the job requires it.

Craft training programs also should be evaluated continually against the criterion of "supply-versus-demand" to determine whether a program should continue and how large the enrollment should be In the past five years, for instance, dozens of schools have created or upgraded welding labs (typically costing approximately $300,000), while reports indicate that in the next few years thousands of journeyman welders will lose their jobs, the result of implementing automated welding processes

Training Technicians

Technicians require more than a high school education, but less than that provided by four-year postsecondary institutions They must be trained in a well-designed curriculum that is comprehensive and, probably, demanding. In the past, many technicians have entered industry after having been trained in the military. In the future, however, most of our technicians for advanced-technology industries will come from two sources.

1. Postsecondary programs in community colleges and technical institutes

2 Special Retraining programs designed for workers from industrial jobs that have become—or soon will become—obsolete.

Students who enter public postsecondary technical programs typically fall into two groups students eighteen to nineteen years old who enter immediately after high school graduation and older adults who return to school because they are attempting to make a significant career change. The public education programs that most successfully meet the needs of its students offer remedial courses to those who are not sufficiently prepared either technically or academically

In cooperation with two-year postsecondary institutions, public high schools also serve a role in training technicians through two plus two articulation programs Simply stated, two-plus-two articulation is an agreement between a high school and a postsecondary institution that enables a student to begin an associate degree or its equivalent while still in high school, beginning with the

eleventh grade Under prescribed conditions, credit for certain high school courses is given by the postsecondary, degree-granting institution.

TECHNICIAN TRAINING PROGRAMS

If today's technicians are to support the national competitive edge by being diversified, problem solving workers who focus on quality and productivity and who remain retrainable and responsive to change, they are being asked to assume roles with new significance and responsibilities in business and industry. Consequently, the curricula that train them need to be reconsidered and, in many cases, redesigned.

Characteristics Employers Want in Technicians

The reports of hundreds of employers have confirmed that they want technicians who—

- understand how systems and subsystems are interrelated.
- possess a combination of knowledge/skills in mechanical, electrical, fluid, thermal, optical and microprocessing devices.
- have a strong base in applied math and science and are capable of learning new specialties as the technology changes.
- are adept in the use of computers for data acquisition, storage, manipulation and display, for automated control of machines; for use in design.
- have the ability to read, write, listen, speak and work with other people—in technical teams, with others in the organization, and with customers.

Curriculum Changes Needed

The characteristics that employers require in their technicians call for three fundamental changes in technical curricula

1 Increase the interdisciplinary content of curriculum materials If we examine what's inside most modern technological equipment, we find combinations of devices—electronic circuits, gears, belts, mechanical linkages, motors, hydraulic systems, pneumatic devices, optical sensors, heating/cooling equipment and a computer. If a computer or some other electronic circuit malfunctions because it is not cooled properly or a motor "burns out" because a gear system is misaligned or "frozen," who is supposed to fix these problems? The electrical

technician? The mechanical technician? The computer technician? Today, the services of all three would probably be required

Equipment has diversified but technical education and training programs still produce narrow specialists Industry hires them because that's all that is available New technician curricula should provide a broad base in electrical, electronic, mechanical, fluidic, thermal, optical and computer technologies As student-technicians learn the interrelationships between these fields, they acquire an orientation toward "systems"

2 Teach the principles Today's technicians are the bridge between theory and hardware They know equipment, tools and instrumentation, and they can work well with their hands. But they also must be able to work intelligently—with their minds. To solve problems in today's complex world of technology, merely knowing **how** something works is not enough, knowing **why** is equally important Knowing **why** means understanding the operating principles of the technology as demonstrated in real applications.

Teaching principles calls for a substantial curriculum emphasis in applied math and science. Applied academic courses should not be "watered down" academics. Rather, "applied" means that they are taught with relevant examples and applications labs wherever possible.

Departments of vocational education in forty-six states have already begun addressing the need for applied academic courses Joining together, these state departments sponsored the development of a high school course in applied physics called **Principles of Technology** This course has been developed, tested, and revised By the fall of 1987, it will have been implemented in 500 to 1000 schools. Developed at a cost of approximately $3 4 million, this cooperative project has proven that many low-achieving high school students in the general track can perform very well in an academically rigorous course like physics if the principles are taught through relevant, hands-on applications Development of similar courses in Applied Math and Applied Communication are underway

3 Develop interpersonal skills Recently, a series of on-site interviews were conducted with twelve major technical companies in a large midwest metropolitan area In the course of each two-hour interview, the employer was asked, "If you could, what single characteristic would you change in the technicians you currently employ?" All twelve employers strongly emphasized that their technicians ought to have better interpersonal skills, and that these skills are needed both inside the plant and outside the plant.

Inside the plant, the employers said, technicians need to be team players who can cooperate to achieve common goals They also need to be able to communicate effectively through speaking, writing and by using graphics. Externally, service technicians are the representatives of the company to customers—many of whom may not have an appreciation for the technical problems with which they deal They just want things fixed—in a timely and pleasant manner

In addition to being experts, then, technicians are required, with increasing frequency, to serve as public relations representatives

THE CORE CURRICULUM: AN EFFICIENT AND COST-EFFECTIVE APPROACH

Fortunately in this decade, educational institutions have begun to recognize the need for technical education that is broad-based and focused on teaching principles. The movement, however, is slow and inconsistent and, in most cases, it lacks state leadership. The process would benefit greatly from clearly identified statewide curricula in the various technologies—and curriculum development should be guided by the concept of the common core.

A careful examination of the curricula needed for eight to ten different technical fields reveals that over two-thirds of the courses are common to all fields. This suggests that a "common core" curriculum could be implemented to serve the education and training requirements of nearly all the technologies A curriculum designed to produce broad-based systems technicians should be made up of two main parts a common core and a specialty sequence. This curriculum structure is shown in Figure 1

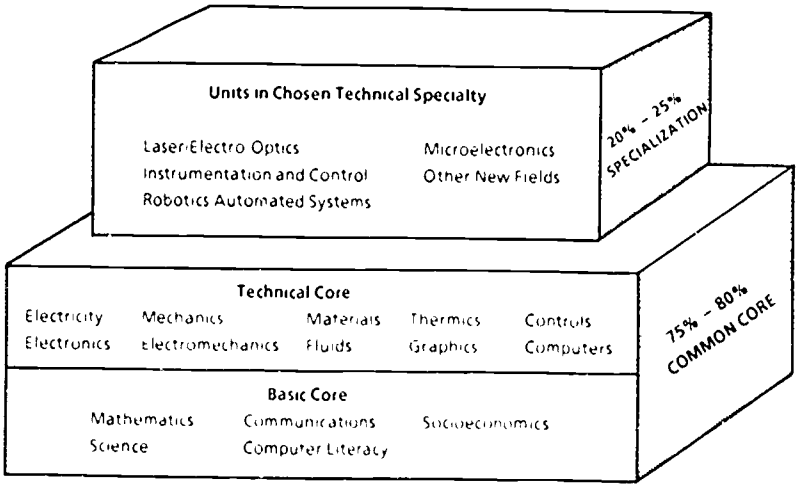

Figure 1 Core curriculum structure

The common core has two components. a basic core and a technical core The basic core consists of courses such as algebra, physical sciences and socioeconomics The technical core provides broad-based skills in areas such as electronic devices, fluid power and the properties of materials. This depth of study prepares the technician for concentrated coursework in a specialty area

The second part of the curriculum, the specialty sequence, ensures that the student attains a level of expertise in a chosen high tech specialization The specialty sequence usually consists of five

or six courses Curriculum paths to become a technician in specific areas of specialization are shown in Figure 2

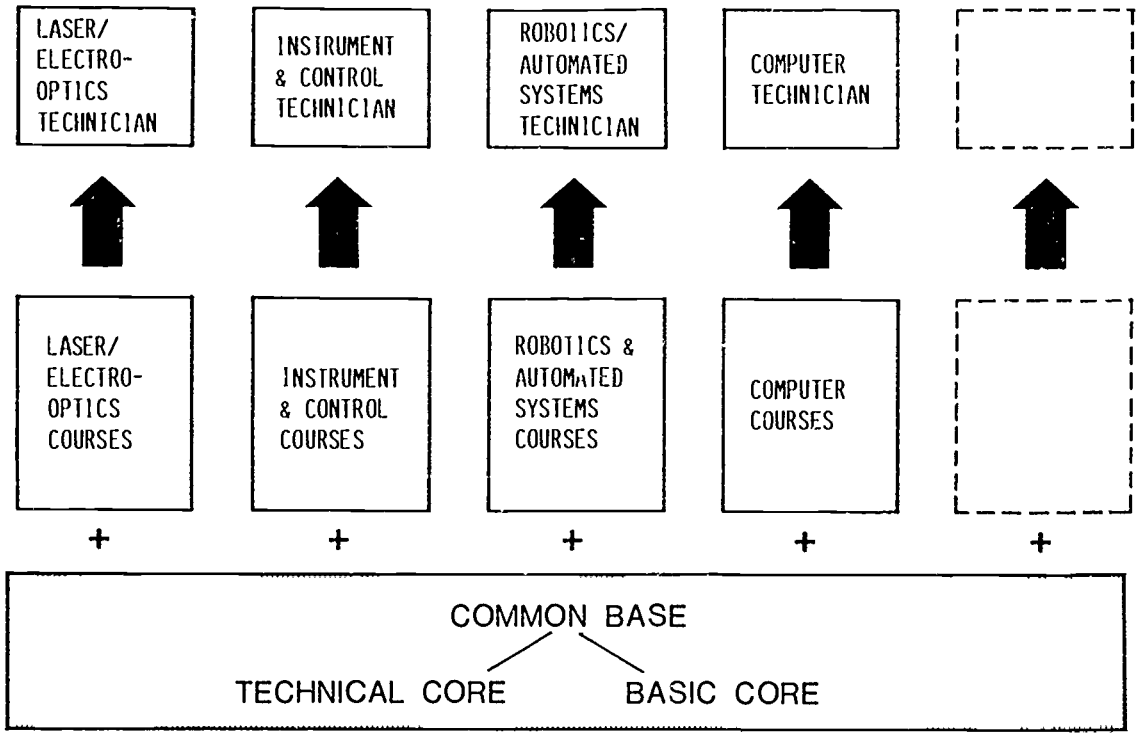

Figure 2 Advanced-technology curricula

The combination of the common core curriculum and specialty courses ensures that a technician will have the broad knowledge base and flexibility needed to function efficiently in advanced-technology occupations As can be seen in Figure 3, the common core makes up the greatest part (more than 75%) of the technician's training

A partial listing of the high tech fields of specialization that can be supported by the common core curriculum includes. computers, telecommunications, computer-aided design, robotics/automated manufacturing, instrumentation and control, laser/electro-optics, intelligent building management, biomedical instrumentation, and biotechnology

The majority of the technical core is founded on a basic core course called Applied Physics—A Systems Approach It provides a broad knowledge base and directly supports high tech occupational competency in four types of systems—mechanical, electrical, thermal and fluidic The emphasis in this course and other courses in the core curriculum is on practical applications, real-world examples, and helpful, unifying analogies of physics principles that enable a technician to treat problems in all these systems with the same relative ease and competence

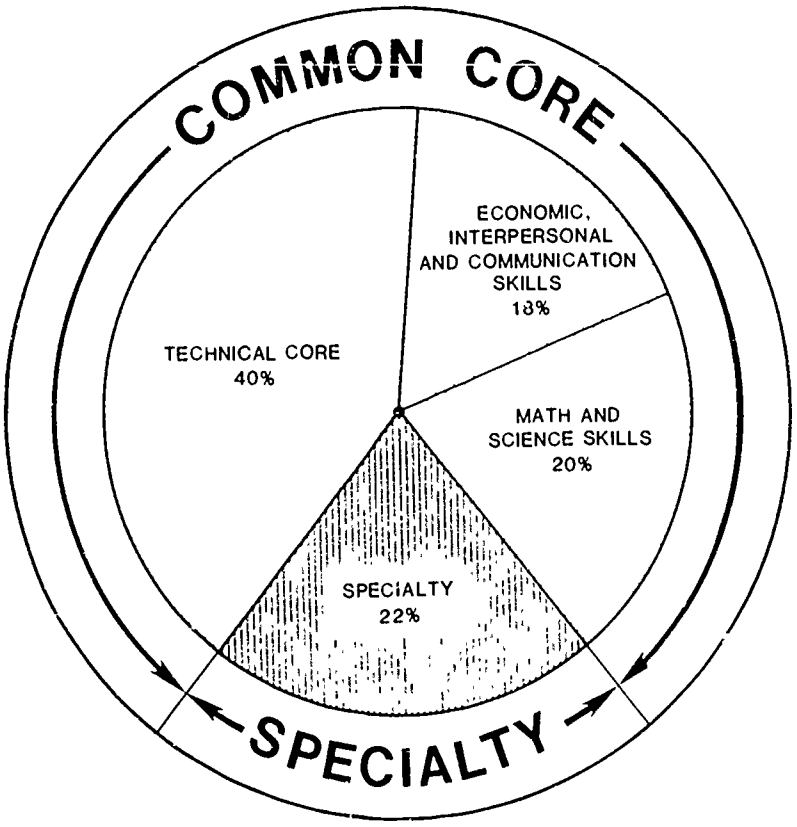

Figure 3. Proportional view of core curriculum.

In traditional schools where several related engineering technology programs exist at the same time and the **core curriculum** is not offered, courses equivalent to the technical core courses are offered separately to each of the several types of technicians. This is not efficient In schools where the core curriculum is offered, these same courses may be combined into common basic core and technical core classes for all technologies. This consolidation reduces the number of such classes, makes better use of teaching staff, and is more cost effective in terms of classroom and laboratory facilities In other words, schools can provide a better product at a lower cost.

Curricula based on the common core concept provide students with a broad-based, systems-oriented education that opens up job opportunities not available to narrowly specialized technicians This broad based preparation also opens doors to lateral transfer or promotion in industry and, effectively, insures against job obsolescence and future unemployment

HOW STUDENTS ENTER TECHNICIAN TRAINING PROGRAMS

Persons seeking entry into technician training programs may be high school students, students just out of high school, older adults who want to make a career change, or adults who need to be

retrained because of job obsolescence Figure 4 shows how these various types of students enter technician training programs

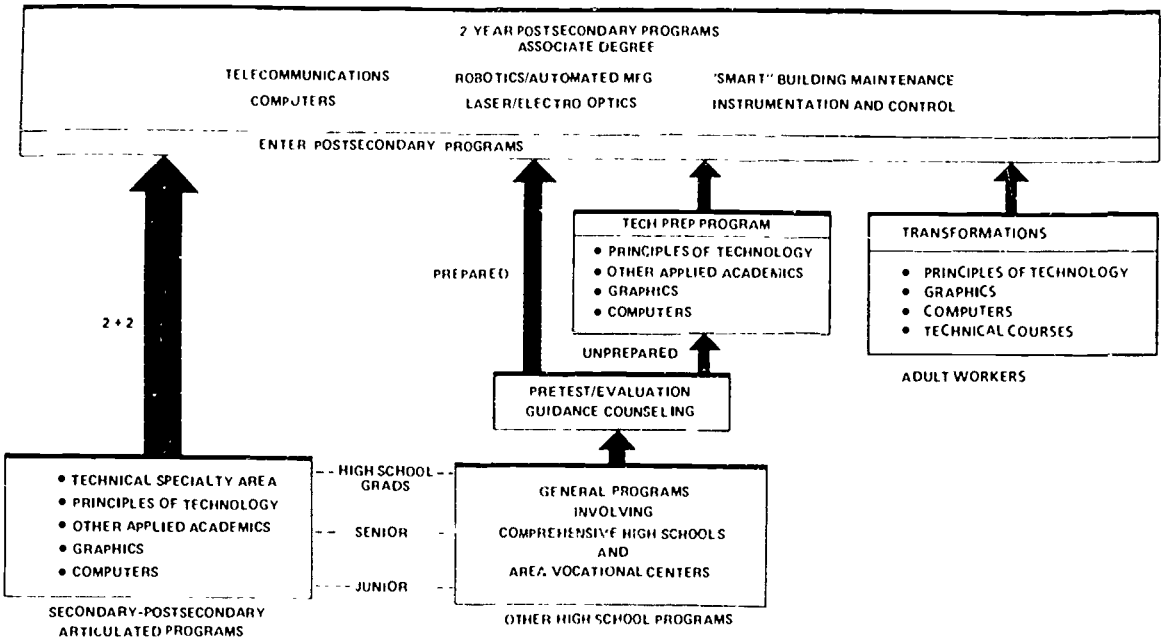

Figure 4. How students enter advanced-technology programs

High School Students and Adults Seeking Career Changes

The path on the left side in Figure 4 is for high school students in the two-plus-two articulation programs This process can provide students with more direction, better preparation for entry into postsecondary colleges and time for co op or work experience The high school portion of the 2 + 2 curriculum begins with a series of applied academic courses in math, science and communications. It also includes courses in computer literacy and technical graphics, and an introduction to the technology of interest

Persons who are not high school students participating in a two plus-two articulation program may need testing, evaluation and "tech prep" training, as shown in the center section of Figure 4 These students may have just graduated from high school, or they may be older adults wanting to make a career change In either case, they probably did not prepare adequately for entry into technician training and will have to take some portion—or all—of the tech-prep remedial program The content of the "tech prep" program is essentially the same as the high school portion of two-plus-two articulation

Retraining Displaced Workers for Technology

As our industries continue the metamorphosis that began early in this decade, more and more semiskilled workers will find themselves in jobs that have or soon will become obsolete. Specific examples of this situation are evident in the automotive, steel and communications industries. These displaced adult workers will have to prepare for new careers. If they want to remain with their present employer or with a related industry, some will seek to be retrained as technicians. Many of these will have poor math and verbal skills and will have had little or no practice in using these skills for the past ten to thirty years.

This past year, a "Retraining for Technology" program was tested in Southeast Tennessee with a group of displaced workers in a copper mining processing operation. This program, called Transformations at Copperhill, presents a new approach for retraining displaced workers for careers in modern technology. It begins with testing and remediation in math and verbal skills, followed by 400 hours of technical training. The curriculum is built on the foundation of the Principles of Technology physics program described earlier. It is supported by courses in technical graphics, computer use, electronics, fluid power and mechanical devices. Since last October, the first group of workers have received this training by attending classes and labs after work, three hours a day, four days a week. They are doing well. They plan to complete the program and take jobs as technician trainees in the surrounding area. Currently they are being interviewed by employers in north Atlanta, representing fields of manufacturing, telecommunications, process control and industrial maintenance.

After they are employed, these retrained workers will be able to continue their education in technology at nearby postsecondary institutions. This path for retraining displaced adult workers is shown on the right side of Figure 4.

What is emerging is a holistic approach to training technicians for advanced technology careers involving:

High school students
Adults involved in career change
Displaced workers

THE NEED FOR COOPERATIVE NETWORKS

The plan summarized in Figure 4 offers a long range solution to the need for the new type of technicians, but it will not "pay off" until considerable resources are invested and several years have passed. In the interim, we must find efficient short term ways to retrain and update our technical workers in the use of the latest equipment, materials, and processes

Vocational, technical and community colleges provide update training and retraining, but they are faced with serious limitations in terms of faculty, up to date equipment, and curriculum development In isolated cases, high-quality retraining courses have been developed and administered in areas such as programmable controllers, statistical process control, laser welding and fiber optics As long as schools work in isolation of each other, however, updating and retraining will suffer from limited resources and duplication of efforts

What is needed, statewide and nationally, is a network of schools that develop new courses and skills and then share with each other Consider this example Suppose School A in one part of the state has developed a course in statistical process control and has a qualified teacher School B in another part of the state has a request from a local industry for a similar course With a cooperative network, School B can access a data base, find that School A has developed the course, and effectively "broker" the course to the industry in School B's service area The course can be taught by School A at School B's facility, taught at School A, or taught by School B using the curriculum developed by School A

RECOMMENDATIONS

The most important group in production teams, the technicians, are in short supply today In addition, many of those that do exist are inadequately prepared to deal successfully with the forces of change so that they can remain in modern technical employment As a result, they cannot participate as effectively as they could or should in the delivery of high-quality, cost efficient products, processes, and services in the modern technological world. They cannot, in effect, contribute effectively to the economic development of our nation

The following recommendations are offered to help solve this problem

1 Program offerings for craft workers, assemblers and operators should be evaluated frequently to determine whether the supply is outrunning the demand Where the need is valid, students should learn principles as well as tools and procedures

2 Technical education and training should be focused on completers at the two year postsecondary level

3 Technician education/training curricula should be restructured along the following lines
   a Core curriculum concept for a cluster of technologies
   b Strong base in applied math, science and communication/interpersonal skills
   c Systems-oriented courses and programs
   d Emphasis on interdisciplinary skills and principles

   Statewide models of core curricula should be developed and tested

4 High school students should be counseled and persuaded to begin preparation for technician education/training in the eleventh grade or earlier through two plus two articulation programs

5 Postsecondary technical programs should not be "watered down" to accommodate unprepared students Instead, postsecondary institutions should test incoming students and place those who need it in remedial "tech-prep" curricula

6 Long-term industrial training programs—designed to upgrade the technical abilities of current and displaced workers—should concentrate on building a strong technical foundation instead of concentrating on narrow training about specific equipment or procedures that are likely to become obsolete within a few months or years

7 Specific retraining/upgrading courses for industry should be offered by public technical institutions through a cooperative statewide network to broker other institutions' courses and eliminate duplication of curriculum development and other institutional resources

National Roundtable on Economic Development
Preface

Leaders from business, education, and government met in Nashville, Tennessee on July 17, 1987 to discuss the evolving role of community, technical, and junior colleges in helping meet the nation's future human resource needs. To stimulate the initial conversation, three policy papers were prepared by Pat Choate, J.K. Linger, Stuart A. Rosenfeld, and Daniel M. Hull.

The diversity of regional, state, and local economic requirements challenged consensus formation, but Roundtable participants did leave the meeting after a long and spirited discussion with an overwhelming agreement in three areas.

First, participants agreed that community, technical, and junior colleges should prepare to play a significant role in the process of creating a more competitive and productive work force. In order to do that, the colleges will have to organize in a variety of ways that best reflect the needs of their local economic community.

As Roundtable co-chair, former North Carolina governor and state community college president Robert Scott said, "Community colleges are uniquely positioned to play a major role in economic development. They're positioned geographically. They offer low tuition. They have an open door philosophy, and community, technical, and junior colleges are positioned to respond quickly."

Dovetailing his remarks with those of Scott, former Mississippi Governor William Winter reminded fellow participants of the economic stakes involved in their discussion. "We can make substantial investments in physical structure . . . we can build four-lane highways and we can create water and sewer systems, but unless we have an investment in human beings that will enable them to compete for higher skill jobs, we will not be competitive at the community level, the state level, the regional level, or at the national level . . . and it is my judgment that the nation's community, technical, and junior colleges represent a key player in helping the American economic community transform the work force to meet present and future challenges. This is a new role for most of the colleges, but it is a more important and vital role than their traditional role."

That position was solidly supported by William F. Willis, General Manager of the Tennessee Valley Authority who stated, "The colleges are in that role. They don't have a choice. They are involved in education and training that impacts economic development and they are going to find that involvement increasing. . . . When a local company says we can't match our new technologies with talented workers, the local college has got to be part of the solution to that problem."

Esther Schaeffer, Vice President of the National Alliance of Business, cautioned that the challenge of human resource renewal was so great and so complex that the colleges should seek broad linkages across all lines to enhance their effectiveness. Schaeffer believes that community, technical, and junior colleges increasingly will find themselves in the role of "convener" and "broker," serving as key institutions in marshalling the assets of the community in the service of human resource renewal.

Secondly, Roundtable participants agreed that the community, technical, and junior colleges could fill a substantial portion of the ongoing education and training needs of a large segment of the U.S. labor population. However, it continues to be imperative that the colleges accurately assess and respond to their local employer community needs. This represents no small challenge as technology drives and complicates business leader decisionmaking to the point that long range projections are difficult to obtain.

Roundtable participants determined that, when making decisions about how to organize their assets as they set about delivering instruction that prepares a competitive and productive work force, it is important that community, technical, and junior college educators continue to respond to the changing needs of students who walk through the open door. They emphasized that care must be taken to see that the "open door" does not become a "revolving" door by becoming academically selective or by becoming prohibitively expensive. Moreover, Roberts T. Jones, Assistant Secretary at the Department of Labor, pointed out, "Thirty percent of the new workers are going to be Black, Hispanic, or women. The average age of workers will be older — 35-39. . . . These folks will reflect major challenges in terms of motivation and minimum competency skills. Other people are going to be moving out of jobs, so some of your clientele is going to be a group of people who aren't particularly excited about being retrained when, in fact, they've been strong union members in high-paying jobs for a number of years." These adults represent a new challenge in terms of training relevancy and curriculum development.

Roundtable participants indicated that community, technical, and junior colleges are a logical delivery system for technology transfer activities, for technical training, for literacy training, for customized training — for whatever training industry needs its work force to have.

Third, Roundtable participants agreed that the "nontraditional" student became the traditional student at community, technical, and junior colleges a long time ago.

"That's something we've already dealt with — and we've been dealing with it to a greater degree than most institutions," said Edward "Sandy" Sanders, Whirlpool's manager of government relations and training in Arkansas.

However, as Flora Edwards, president of Middlesex County College, pointed out, "We are faced now with two conflicting sets of propositions. We've expanded access, and we've upped requirements. We're looking at students as college material whom we never thought were going to be college material."

It was just this conflict that prompted many of the participants to rally behind the concerns of Philo Holland, vice president, Sears-Roebuck and Co. "We need balance between our basic educational mission and possibly economic development . . . I would hope that we do not conclude that as a primary mission economic development should be required of community colleges throughout the country," he said, "because, in fact, job preparation, in my opinion, is a far more important role . . . If we don't have youth, young adults and adults basically trained with a solid foundation of education skills, we don't have much of a chance to go further in high tech kinds of skills."

James R. Adams, president of Southwestern Bell Telephone Company, concurred with Holland in saying, "I'm a business person, so I keep looking for focus when we are talking about economic development. . . The objective ought to be primarily job placement and job training. That doesn't rule out some of the more creative economic development collaborations between the colleges and the economic community. It just means that sort of activity ought to be kept in proper perspective."

Can community, technical, and junior colleges accomplish the goals of economic development that will ensure U.S. global competitiveness? The concensus of Roundtable participants was "Yes, but it will be a difficult job." As Sandy Sanders said, "Whether or not it's articulated as a goal or an established policy, economic development is part of the community college activity, and part of the community college movement."

As for what community, technical, and junior colleges are doing to prove their sincerity, Nolen Ellison, president of Cuyahoga Community College, pointed out, "Community colleges are 'bullish' on economic development. With or without federal legislation, college presidents are out there in the trenches working with businesses."

Roundtable participants were quick to reinforce, however, that it isn't just the community, technical, and junior colleges who must gear up to help our nation become more competitive and productive. Roundtable participants recommended a "multi institutional" approach, setting as priorities collaboration, partnership, and networking between education, business, and government.

"Somewhere along the line, I hope we say this," said Michigan State University President John A. DiBiaggio. "It [gearing up for economic development] isn't solely a community college's function, or a university's function, or a four-year college's function, or a secondary school's function. Quite frankly, we're all in it together, and if we don't all pull together, then the nation is going to be in difficulty. And directly or indirectly, all our institutions are going to be in difficulty."

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ROUNDTABLE OVERVIEW

EDUCATION AND ECONOMIC DEVELOPMENT: MORE THAN A RHETORIC GAME

by Cassy B Jordan
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"Demographics is a fascinating game to all of us," said former North Carolina Governor Robert W Scott as the Roundtable on Education and Economic Development began to wind down for the day Twenty-one education, business, and political leaders engaged in a hard and fast exchange of demographics and the role of the community, technical, and junior colleges on economic development on July 17, 1987 in Nashville, Tennessee And although demographics are not always as clear as crystal, demographics are about the only sound way that educators, politicians, and business people have to predict future trends. So it was a day of demographics and prophesies, sponsored by The Sears-Roebuck Foundation and the Tennessee Valley Authority. It was also a day of brainteasing — and brain-testing — discussion followed by recommendations. Participants used papers written by four of education's trendsetters as catalysts to their discussion.

Little talk was devoted to dollars Some people might find that curious among a group of educators, politicians, and business people who discussed economic development Perhaps the U S Assistant Secretary of Labor explained why best. Roberts T Jones said that in the next few years, "There's likely to be an embarrassment of riches in the amount of training dollars that are available" Jones, who oversees the administration of all Employment and Training Administration programs (including the Job Training Partnership Act), continued, "Not only do we see training becoming one of the top priorities of collective bargaining now, but we have this discussion of ITAs and the tax incentives for corporate investment in training" "ITA" refers to a proposal to initiate individual training accounts, similar to "IRAs," individual retirement accounts

"Congress will pass a billion dollar training program for retraining workers this year in the midst of the worst budget crisis ever I think the list would be substantially longer if vocational education could ever straighten up its political act," Jones said, adding that he believes the amount of voted money will increase In fact, Jones predicted that "there will be more money per American worker between private and public resources in the next 20 years than we've ever seen before," and that community, technical, and junior colleges are going to find themselves "not wondering who pays for it but more involved in the issue of roles and functions and productivity The dollars must be there, because we can all lose in this national struggle for global competitiveness — educators, business persons, and government officials alike There's something at stake for us all," Jones concluded

The focus of the Roundtable talk was on what roles and functions community, technical, and junior colleges should play in economic development activities – and how they can make themselves most responsive, efficient, and productive in the progress. Time and again, the talk turned to demographics and predictions. For example, many quoted statistical soothsayers who predict that the new entrants into community, technical, and junior colleges are going to be Black, Hispanic, and/or female, that the average age of the work force will be 35-39 (older than they are now), and that there will be a sharp increase in immigrants.

"Many of the people who will need training will be angry, particularly," Jones said emphatically, "if they're being trained to be widget makers when they've been strong union members in high-paying jobs for a number of years." Jones proved himself a plain talker more than once. "Sure, it's great to have a beautiful campus, a community college, a technical program, and say 'come on over here — have we got a deal for you.' But it's a fraud in terms of that worker's security and the ability to survive in that labor market — particularly if the substantial portion of them (students) are minorities and women and immigrants and people who have not traditionally participated in the programs and have a weaker basic set of skills.

"I think we're going to have to change the process. A portion of our society has never been looked upon as a significant contributor to the labor force in this country. It's been a social issue, but not a political or economic issue. Now it's an economic issue. Black and Hispanic populations are to a sufficient degree not participating. They're not in your community colleges. They're not benefiting from the process. In the next ten years, either your systems won't be full or these people will be in there," said Jones.

Esther Schaeffer, vice president of the National Alliance of Business, reinforced Jones. "We're talking about students who haven't come close to getting into a community college door, who never made it to high school or made it through high school and are, therefore, undereducated. Yet these are the people that employers will be needing, because the pool is drying up in terms of entry-level workers," she said.

Much of the day was spent determining how community, technical, and junior college programs could meet the needs of this entering group of students at the same time they are meeting needs of a more highly skilled worker. What might be the right activity for one institution or one kind of student might be the wrong activity for another. The concensus became a realization that meeting economic development goals would require highly sophisticated and diverse implementation strategies.

Scheaffer remarked that the solution lies in having community, technical and junior colleges continue to meet a series of needs through a variety of activities. Those activities include 2+2 and 2+2+2. They include customized training. They include some of the more elaborate or extended customized training – or whatever one might want to call the more generic training. "I'd like for it not to include remediation, but it will for awhile because so many of the students aren't going to have it as they come up from K-12," Schaeffer said.

During the discussion, the problem of preparing a work force to ensure economic competitiveness and productivity, i.e., national prosperity, became clear. "The problem," as Schaeffer described it, "is much bigger than any one institution, much bigger than all the public institutions combined, much bigger than the private sector can handle. In different communities, there are different institutions, both public and private. These institutions have to get together and sort out roles and responsibilities," Schaeffer said.

What are those roles and responsibilities? Scott set the stage for those answers at the discussion's outset when he said, "There's a research triangle that's even more important than the one in North Carolina. It's the significant triangle of interaction that's evolving across the country between government, business, and education."

Community, technical, and junior colleges will play a significant role in that triangle. "An avalanche of responsibility for educating the U.S. population is going to be placed on community colleges," warned Washington, D.C. Federal Laboratory Consortium representative Lee Rivers.

Part of that avalanche will be meeting the growing need to retrain adult workers. As Middlesex County College president Flora Edwards said, "Without the proper support by educational institutions, we'll have an awful lot of people competing for jobs that don't exist, and not enough people qualified for the jobs that do exist. The terminal degree is a myth in a climate that requires lifelong learning. By the year 2000, an illiterate will not be one who can't read. An illiterate will be one who can't learn, unlearn, and learn again."

The ability to train and retrain the necessary work force is the key to enticing businesses into a community. Former Governor William Winter of Mississippi shared an anecdote that illustrates this point. "As governor of Mississippi, I've been frustrated by having seen a time lag that was catching up with us. I recall with great disappointment the experience I had just weeks after I was inaugurated.

"The director of our department of Economic Development called me at the mansion and said, 'I've got some good news. You're going to be able to announce the location of a major electronics plant — a high-skilled, high-wage company that's coming to Mississippi.' I could savor the experience of standing up in front of all those TV cameras and talking about this plant that I could take no credit for having gotten, but which was coming fortuitously, just as I was inaugurated as governor. But I got another call — same man — who said, 'I have some bad news. The company I told you about isn't coming.'" Winter stopped for a moment to let the Roundtable simmer.

"I called up the CEO. I met with him. He said he liked everything about Mississippi — the business climate, the structure, the transportation, the community attitude, the location, the distribution facility. 'But we took a survey at the last minute,' he said, 'and we weren't satisfied that Mississippi had an educational structure that was capable of producing the skilled people we need,'" said Winter.

He paused again, and then added, "I came back to Mississippi. I called a meeting of the heads of the junior colleges and others. I told them that story. Out of that experience, I think we began to develop an understanding of what's involved. We can build four-lane highways, create water and sewer systems, make all kinds of investments. But unless we have an investment in human beings out there that will help them be competitive for jobs that call for increasingly higher skills, we're not going to be competitive."

Most of the day, however, was devoted to discussion that hinged on finding ways to be collaborative, to be cooperative. There was talk of linkages, partnerships, and networks, about how the community college is uniquely positioned and is not an "ivory — or maybe kudzu-covered" institution, as former Governor Scott described other institutions.

Cuyahoga Community College District president Nolen Ellison said this country "is not a neophyte in terms of taking theory and applying it in practical context. . . . We've demonstrated to the world that we can take federal resources and make them state-focused and community-based to move theory to practice in converting human resources to meet economic development needs." About his colleagues in the American Association of Community and Junior Colleges Ellison said, "We're not imbued with the ivory-tower notion that presidents ought not to be out in the trenches building partnerships."

Edwards followed Ellison's remarks with the question, "How do we forge partnerships, not only with industry, but with our major research universities?"

Rivers cited a problem rather than giving an answer. "We can still generate plenty of basic scientific knowledge. However, I think one of the critical problems that we have finally recognized is that the nation has an inability to convert knowledge into technology in the form of goods, products, and services to compete in the world marketplace. Community colleges . . . should position themselves in the applications end of the R&D spectrum."

Rivers' position was seconded by Bill Willis, general manager of the Tennessee Valley Authority. Willis described how TVA worked with local community colleges to help produce a more highly skilled work force by retraining 1700 workers in East Tennessee. He also described a partnership between a community college and General Motors in Alabama to develop a work force that had the basic skills GM wanted. Willis praised community colleges for meeting the challenge of developing higher levels of literacy among workers who need remedial help. "But," Willis said, "we're going to have a look at the whole division of labor between our . . . colleges . . . to see that programs dovetail and support one another. This 2+2+2 thing is a way to get at that. It's going to be a terrific political job to overcome [existing barriers] to do it. But folks, we've got to roll up our sleeves and go to work because the demands have been placed on us, and we've got to get at it."

The models we use across the nation to achieve economic development goals vary widely. Al Lorenzo, president of Macomb Community College, cited three reasons a national policy on ways community, technical, and junior colleges could address economic development needs would be impossible to implement. "First," according to Lorenzo, "community colleges evolve in dramatically different ways across the United States. They see their roles differently, depending on their perception of their mission. Second, each state's economic strategies may be different. Third, the structure of each state government may be different, making the ways in which they deal with colleges different from state to state."

Roundtable participants also discussed the need for balance. Philo Holland stated, "We need balance between our basic educational mission and economic development. If we don't have people who are trained with a solid foundation of skill and understanding, we don't have much of a chance to go further in high-tech kinds of training."

Participants were reluctant to limit the scope of community colleges, yet quick to point out that community, technical, and junior colleges should work to recognize that they are only part of the framework with the capacity to educate. Monty Multanen, immediate past president of the National Association of State Directors of Vocational Education, pointed out that the "network of community colleges within a state can be a tremendous resource for doing things like small business development centers."

Esther Schaeffer added, "We should avoid the tendency to look at the community college system in isolation and not to recognize the whole host of institutions in various communities, be they universities or other training facilities. It's incumbent upon community, technical, and junior college representatives to define their role in relation to whatever else is out there in their community," said Schaeffer.

One of those roles is in job creation, and in creating the right kind of worker to fill those jobs. Jim Adams, president of Southwestern Bell's Texas operation, explained, "When Bill Clements, our current governor, asked me to look at job creation in Texas, we found that we didn't have the infrastructure that would yield trained employees. It's a much sexier topic to talk about employees with graduate degrees, to have a certain atomic scientist that can do this and this and that — or a Nobel laureate. But businesses are looking for people who are trained in biotechnology or lasers — who know how to read and write — who know how to work with people with a business-like mind when they walk from door-to-door fixing telephones."

Scott concurred with Adams, but pointed out that there were some interesting conflicts in what business says it wants. He referred to a series of small conferences held recently in North Carolina with representatives of industries, metal working, agribusiness, chemicals, electronics, and the textile industry. "I asked them to come sit with me and a couple of our senior staff," Scott said. "What we found out was that our CEO's want people who can think and who can make judgments. They said they can teach them skills. And middle management? Middle management wants somebody to do damned well what he's told and not to think! But they agree on one thing; they want us to stay in touch. Otherwise, they said, we'll be out of the ball park and won't be doing them a service," Scott said.

Al Lorenzo cited a similar circumstance Over the last two-and-a-half years, Michigan Bell Telephone Company has conducted 1600 face-to-face discussions with manufacturers in Southeastern Michigan. "Sixty-nine percent of them said they don't require a high school diploma for employment," said Lorenzo. "I guarantee you that those same manufacturers will be angry in five years because their work force isn't retrainable. So I think instead of asking industry for dollars, we should be asking industry to begin requiring successful high school completion so that there's at least some standard," he said.

Ralph Doshier, corporate education manager for Texas Instruments (TI), said, "Technology turnover requires us to do continuous retraining. Our biggest problem right now is finding qualified people, qualified technicians. We can find all the engineers we want." Doshier pointed out that TI requires the Associate of Science degree and that company-sponsored efforts to get the current work force at TI upgraded at local community colleges met with problems. "The issue is how you get a vast pool of people who never even got through high school to have the desire to not only finish high school, but go on to develop marketable skills," he said

DiBiaggio said the problem isn't restricted to Michigan or Texas industries "In my discussions with Lee Iococca, Roger Smith, and Don Peterson — all of whom I know well — we talk about these matters . . . the fact that they're employing someone on the assembly line today who must have certain kinds of analytical capabilities, be able to read intelligently, and who must be able to deal with the technology they face. . . . Too many of our students coming out of high schools do not have those abilities. I tell our students that the most important skills they'll acquire while they're at our institution are the abilities to think clearly, to view and to listen and read intelligently, and to be able to analyze information, synthesize it, and be able to apply it to their lives — because society is so dynamic that this is the only way they're going to be able to survive The fact of the matter is that they do acquire that capacity, no matter what discipline they study," said DiBiaggio, who added that young people are now mature enough to make career decisions while they're in high school, and that our society "has prolonged artificial childhood."

Chet Francke, general director of Joint Education Activities and responsible for joint education programs administered by UAW and General Motors, said that he was "curious about the absence of the word 'student' in any of the questions or any of the material. There's a lot of concern about what our employers are interested in, and it seems to me that ought to be an issue that's not missed when you're talking about the role of an educational institution."

Responding to Francke's concern, Ellison stated, "That's where local college leadership is going to arise," emphasizing that community colleges must keep their role as a service provider to students sacrosanct.

Former Governor Winter shifted the discussion a few degrees by pointing out the unique role and opportunity community, technical, or junior colleges have in a rural setting. Winter, citing the negative economic pressures in rural America, supported the position of author Stuart Rosenfeld that there must be a network of assistance for rural area economic development Winter reiterated his contention several times during the day that a "community, technical, and junior college role in economic development is one of the most essential elements in the preservation of the vital rural economy that, in turn, supports numerous rural communities throughout the nation"

Edward Sanders, manager of government relations and training for the Whirlpool Corporation in Arkansas, joined in the assessment. "In the rural areas, more so than urban areas, I think community colleges must be directly involved in helping their local community. The rural college has a lot of power that can contribute significantly to the overarching community strategy in local economic development The rural community really has an obligation to be a dependable catalytic agent for economic development and growth," he said

Nick Nichols, in his third term as executive vice president of the Communications Workers of America, addressed the question of leadership. "I recently looked at a number of grant requests from various community colleges. Nine out of ten of them deait with setting up new businesses. If you're going to increase students, you're going to have to have something that appeals more to the person who pays the taxes. I think setting up new businesses is great . . but I think you have to be very, very careful that what you do benefits the community and doesn't just make one entrepreneur rich while bringing in only low-wage — very low wage — industries into some places. So what you're doing," said Nichols, "is using tax money to bring in an industry that would get one or two people rien while the rest of the people continued to work at very low wages."

Like Nichols, Bill Willis talked about students, saying what we have now is basically what we get, at least until the year 2000. "It will be the year 2000 before we will see the results of an increase in the birthrate. We have a great task ahead of us to retool this work force, the one we have now. If we're going to be competitive over the next 15 years, we're already in the game. We have to concentrate on that," Willis stated.

Chet Francke concurred. "Retraining your current work force becomes a very critical issue. You can't always go out and hire the skills you want. You have to build them inside. We have 600,000 employees. We have about 50 to 75 thousand who are illiterate, and that's a problem we're concerned about. We're also facing a very serious problem with dislocated workers. We've announced plant closings that will idle about 40,000 employees between now and 1990. . . . The budget for our [retraining] activity is about $200 million a year I think it's about $600 or $700 million annually for the corporation as a whole. . . . The community colleges have been very useful in helping us in our training/retraining efforts Our headquarters is built on the campus of Oakland Community College and several of our other UAW/GM Centers are built on leased community college property. That's the beginning of a close relationship, and it extends to more than just landlord/tenant," Francke explained.

Retraining adults was on every Roundtable participant's mind. In that regard, Monty Multanen said he hopes the concept of 2+2 and 2+2+2 "stays on the front burner as a national focus because it's driving the right kind of people local secondary and postsecondary educators, business persons, government representatives around the table, to end up making more efficient use of resources. I think the students will respond. . . I think any time we can make resources between the elementary, secondary, and postsecondary schools more effient, we're freeing up dollars to take care of what I see as this huge, increasing need for retraining our adult population," Multanen said

Al Lorenzo emphasized the priority to prepare students well. "At the risk of sounding negative, I don't know of another industry in the world that's paid fully for products that don't work — well paid, in fact. K-12 districts can get full-people funding when students go back the second and third time through adult education programs. We in the community college sector don't get full-people funding for the people in our regular programs, so that's an incentive to not make education work the first time," he said.

And so, amidst the demographics and the prophesies, the talk did eventually turn to dollars, with Nichols, Francke, and Doshier agreeing that industry and government must work together to continue to ensure that the dollars for training are there. Because, the way they see it, industry always pays and is willing pay, in one way or another. It is simply a question of making their investment count. It was business and government, after all, who financed the Roundtable discussion. In the twilight of the discussion, Jim Adams of Southwestern Bell, broached the topic of accountability. "I'm convinced that there are two subjects that'll raise a crowd anywhere you go — sex and economic development," quipped Adams. "It's just something that we love to talk about these days . . . The problem is, we end up talking about it, a lot of words. The question is, is something happening? I'm afraid . . we'll end up doing the same thing. It'll be more of a turf issue than it will be dividing and taking a territory, the way we do a war. You do this, another person does that. I think the job of community colleges ought to be job placement, job training . . doing whatever seems to work toward creating a better-equipped work force," said Adams.

In the end, it was more than a day of quoting demographic data, proclaiming prophesies, or worrying about who pays. It was a day of planning, the kind of planning generals do before a war. And, as in war, the education, business, and government leaders sitting around the table on Friday, July 17, 1987, focused on strategies. Now, they say, it's time for all good men and women in community, technical, and junior colleges to marshall local human resources and get down to developing tactics in this forced march toward our nation's economic development.

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ABSTRACT

In 1987, a national roundtable was held to discuss ways in which two-year colleges can help foster productivity and economic development. This report contains the background papers used to initiate group discussions, an overview of the highlights of the roundtable, and the recommendations of participants. Following introductory comments on the roundtable, the three issue papers are provided: (1) "Preparing for Change," by Pat Choate and J. K. Linger, which examines trends in technology, trade, and demographics and their implications for education; (2) "Technical and Community Colleges: Catalysts for Technology Development," by Stuart Rosenfeld, which offers brief descriptions of regional, state, and local initiatives in technology transfer, technical assistance, brokering, research, development, testing, the creation of a high-tech learning environment, worker retraining and skills upgrading, and continuing education; and (3) "Preparing Technicians for a Competitive Work Force," by Daniel M. Hull, which advocates cooperation between community colleges and high schools to develop "2 + 2" articulated curricula and presents a training model to address the interdisciplinary skills needed by advanced-level technicians. In addition, the report provides summaries of roundtable discussions and a list of the 11 resulting recommendations. (AYC)

REPORT AND RECOMMENDATIONS

National Roundtable on Economic Development
July 16, 1987 • Nashville, Tennessee

The Role of Community, Technical, and Junior Colleges in Technical Education/Training and Economic Development

Community, Technical, and Junior Colleges
Key Partners in Economic Development
For The 21st Century

AACJC

This report has been prepared specially as a resource for The American Seminar III, Community, Technical, and Junior Colleges Key Partners in Economic Development for the 21st Century The National Roundtable, sponsored by the Keeping America Working Project and the Center for Occupational Research and Development, was funded by the Tennessee Valley Authority and The Sears-Roebuck Foundation

THE ROLE OF COMMUNITY, TECHNICAL AND JUNIOR COLLEGES IN TECHNICAL EDUCATION/TRAINING AND ECONOMIC DEVELOPMENT

A NATIONAL FORUM

Sponsored by:
The American Association of Community and Junior Colleges
and
The Center for Occupational Research and Development

Funded by:
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The Sears-Roebuck Foundation

INTRODUCTION

Two-year colleges can play a pivotal role in improving our nation's productivity. Recognizing this fact, the Tennessee Valley Authority and The Sears-Roebuck Foundation funded a national forum that was sponsored by the American Association of Community and Junior Colleges and the Center for Occupational Research and Development. The purpose of this coalition was to investigate ways in which two year colleges can help foster productivity and economic development.

Prior to the Roundtable meeting, four authors wrote three companion papers that provided a springboard to the group discussion (but did not limit discussion parameters). All four authors, Pat Choate, J.K. Linger, Stuart Rosenfeld, and Dan Hull, raised issues and concerns. Choate and Linger painted the big picture in terms of national movements, trends, and indicators. Rosenfeld focused on regional, state, and local initiatives in work force education and training. Hull's paper spotlighted the needs for a holistic model training strategy that addressed the interdisciplinary skills needed by tomorrow's technicians.

Each author offered solutions and or recommendations to some of the nation's future human resource challenges. Roundtable participants reacted to issues raised in the papers as well as other pertinent issues. The Roundtable was comprised of national leaders from government, the private sector, labor, and education Roundtable participants were encouraged to draw upon their experience and expertise as they examined critical issues and formulated solutions and recommendations.

This document contains the three papers used to spark Roundtable discussion, an overview of the Roundtable highlights, and the recommendations from the Roundtable participants. The information and ideas generated at the Roundtable will be featured at an AACJC national video teleconference on September 29, 1987 Additionally, the final report will be distributed to major economic development and education institutions throughout the nation.

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Tennessee Valley Authority

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American Association
of Community and Junior Colleges

June 1987

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PREPARING FOR CHANGE

Pat Choate, Senior Economic Analyst
and
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This paper points out the need to adopt a U. S Comprehensive adjustment training strategy Vocational educators are being called upon to define a comprehensive approach that will expand training policies to encompass the needs of the entire work force—the disadvantaged and impaired worker, the new worker, the displaced worker, and all workers who will be needing lifetime skills improvement. To assist in this effort, a greater financial investment by employers is required. Choate and Linger suggest that it is time to clearly define who is responsible for training and the resources necessary to fuifill this obligation.

Executive Summary "Preparing For Change" by P. Choate and J. K. Linger

The future of the U. S. labor sector will feel the impact of (1) the accelerating influence of technology on work and jobs, (2) America's deepening involvement in the global economy, and (3) irreversible global demographic shifts. Technological change is having its most dramatic impact on the automation of production.

Foreign countries, such as Japan, Korea, Taiwan, etc., have presented a competitive challenge to the U S business, financial, educational, government and labor sectors This challenge is directly affecting the U. S worker The appropriate response to this challenge is a better educated, trained, and more productive work force.

Demographic factors involved include. (1) the post-World War II baby boom is maturing, (2) older workers are choosing early retirement, (3) the growth of the work force is slowing as the average age of workers is increasing (25-54), (4) approximately one million women per year will be added to the work force for the balance of this decade, and (5) there is a shifting distribution of younger and older workers.

Specific impacts that will be felt because of these demographic factors are (1) an increased importance on retraining and adjustment for adult workers, (2) a greater demand for worker skills to keep abreast of individual job demands, (3) the role of women in lifetime careers, (4) shortages in the military and civilian labor force due to the decline in number of young people, (5) competition between business and the armed services for entry-level workers, (6) the growing pressure for people to continue working past retirement age, and (7) necessary attitude changes and employment policies.

Older workers face several unique problems, (1) job discrimination, (2) inadequate preparation to find work or meet the challenges of new jobs, and (3) an inability to adequately handle the rejection that accompanies their plight. In addition, few employers adequately educate their executives on how to best manage workers as they move through their forties, the legal age to be considered a displaced person, their fifties, sixties, and beyond.

The keys to economic change rest with the creation of enough jobs for all who wish to work and if these people can be prepared for these jobs. If this can be accomplished, new technologies can be quickly introduced and U. S. involvement in the global economy can be expanded To accomplish this, workers must be able to secure lifetime education and training All sectors involved must be able to flexibly provide financing and creative ways to bring about this training

One place to start is with small firms and entrepreneurs. They will provide 70% of the new jobs and are noted for looking outside for their education and training needs. All workers will need "booster shots" of education and training throughout their careers. It is certain that many workers already face the prospect of occupational obsolescence and displacement Other workers can expect to change occupations three times and jobs six to seven times during their careers.

The ultimate goal should be to adopt a U S. comprehensive adjustment and training strategy Vocational educators can a isume a pivotal role in this quest by defining a comprehensive approach Training policies must expand to encompass the needs of the entire work force of (1) disadvantaged and impaired workers, (2) new workers, (3) workers needing lifetime skills improvement, and (4) displaced workers To assist in this effort, a greater financial investment by employers is required. Most of all, a clear allocation of who is responsible for training is required. Only then will the obligations and resources reside with those who are best prepared to meet this challenge.

PREPARING FOR CHANGE

The Technology Factor

The Trade Factor

The Demographic Factor

The Arithmetic of Change

Implications for Educators

Recommendations

PREPARING FOR CHANGE

Pat Choate and J. K. Linger*
TRW, Inc.

From the vantage point of the 1980s, the sweeping changes wrought by the Industrial Revolution are obvious. But even a century ago, knowledgeable Victorians were able to anticipate much of what was to come.

Jules Verne predicted submarines and trips to the moon. Edward Bellamy, the nineteenth-century futurist and author of Looking Backward 2000 – 1887, foresaw in 1886 a twentieth-century America radically transformed by credit cards, supermarkets, occupational safety, a short work week, assured pensions, early retirement, Walkman-like listening devices, free education for the masses, and women working outside the home on an equal basis with men.

Just as discerning Victorians could anticipate many of the realities of the twentieth century, so too we can foresee many of the economic, political, and social shifts that will shape people's lives in the twenty-first century. In fact, three of the most powerful forces that will shape our future are already apparent. the accelerating influence of technology on work and jobs, America's deepening involvement in the global economy, and irreversible global demographic shifts.

Individually and collectively, these are the economic, social, and political equivalents of icebergs on the move—only partially visible, yet enormously powerful and capable of altering or destroying all that lies in their path.

The convergence of these forces has far-reaching implications for business, unions and government, for financial institutions, and most important, for the people who are doing the work and the educational institutions that must prepare them for that work.

THE TECHNOLOGY FACTOR

Technology is the wild card of the future. At an accelerating pace, it is creating dazzling improvements in goods and services, generating millions of new jobs, revitalizing old industries, and spawning entirely new ones. It is rendering established products and processes obsolete, eliminating millions of existing jobs, and rapidly transforming millions of others.

*Pat Choate and J. K. Linger are authors of the new book, The High-Flex Society Shaping America's Economic Future (Alfred A Knopf, Inc , 1986), from which this article is adapted

Improvements in optical fibers, for instance, have created a communications cable that can carry ten thousand times more information than one made of copper, eliminate almost all noise, and make unnoticed monitoring virtually impossible—all at a reduced cost Advances in space-based telecommunications have also produced better, less costly service In 1965, a single satellite carried only 240 telephone circuits at a cost of $22,000 per circuit, today's satellite carries more than twelve thousand circuits at a cost of less than $800 per circuit.

Technological change is having its most dramatic impact on the automation of production. It is bringing remarkable improvements in quality and immense savings in labor costs. on average, one robot can replace six workers, and every $1 dollar invested in robots saves $3 in other production costs by improving product quality and by increasing output, material savings and flexibility.

The widespread availability of technology is also shifting competitive advantage among industries, firms and locations worldwide. When the Yamazaki Machinery Works in Japan introduced its highly automated flexible management and manufacturing system in 1983, for example, its Minokamo plant was already one of the world's most advanced machine tool factories. With less than one-tenth of the nearly 3,000 workers needed in comparable conventional facilities in the United States, the plant could turn out a compact numerically controlled lathe in two weeks, compared with three to four months for Yamazaki's foreign competitors.

Using the new super automatic system, however, the Minokamo plant can now match its previous output with only one-fifth the personnel (39 employees compared with 195 using the old system), less than half the equipment (43 pieces compared with 90), two fifths of the floor space (6,600 square meters compared with 16,500), and one-third the process time (30 days compared with 91). The new plant requires no engineering drawings, moreover, because the new production system is connected to the CAD/CAM Center at Yamazaki headquarters nearby

If American manufacturing operations are to regain their competitiveness, they too must have the cost savings, flexibility, and qualitative improvements that automation makes possible Many workers will lose their jobs in the process and require retraining for other work. At the same time, millions of other workers will require new and improved skill. to build and operate the factories of the future.

THE TRADE FACTOR

During the past 25 years, the United States has shifted from relative economic isolation to global interdependence By the mid-1980s, trade accounted for 20 percent of the U S GNP, up from 10 percent in 1960

As a result, work in America has become increasingly dependent on world trade American farmers, for instance, sell 30 percent of their grain production overseas American industry exports

more than 20 percent of its manufacturing output, and the job of one of every six manufacturing workers depends on foreign sales

At the same time, a fifth of all goods sold in the United States comes from abroad. Americans buy 36 percent of Japan's exports and 33 percent of Latin America's. They also purchase 60 percent of the manufactures that Singapore, Hong Kong, South Korea, and Taiwan export to the industrialized countries. Any significant reduction of U. S. trade would create havoc in the American economy and pitch our trading partners into economic, political and foreign-policy upheavals.

America's trade competitors are competent and sophisticated. Most have mounted aggressive efforts that represent nothing less than a new form of societal competition in which a nation's full economic resources are marshalled in the global economic sweepstakes Japan, Korea, Taiwan, Brazil, France, West Germany, and other industrial and developing nations have created national economic combines of government, business and labor. They select a few key industries which will be favored, reduce the risks of investing in these enterprises by giving them infant industry protection, and facilitate large-scale economies of research, development and production.

Virtually no national effort is spared. Promising foreign technologies are identified and secured. Basic research is cosponsored and shared A leading foreign company such as U. S Steel, Texas Instruments, General Motors, or IBM is selected as a model and economic pace horse. National cartels are formed. Generous long-term capital subsidies are provided Workers are trained and retrained, often with government subsidies. Product prices, specifications and standards are jointly determined. Aggressive export drives are launched when the industry achieves world-class competitiveness.

The U. S. Department of Commerce reports that while only 20 percent of America's goods-producing industries were subject to foreign competition two decades ago, more than 70 percent are today. American business, government and workers have failed to recognize this competitive challenge and make appropriate responses.

Consequently, one U. S. industry after another now finds itself with its back to the wall. Most of the losses are in sectors where the United States has long been dominant—manufacturing, services and high-tech goods. Foreign firms have captured more than half the U. S domestic sales of computer-controlled machine tools. Since 1960, foreign manufacturers have been able to reduce U. S world market share in auto production from 48 percent to 26 percent, in chemicals, from 66 to 35 percent, in pharmaceuticals, from 62 to 35 percent, and in metal products, from 67 to 43 percent.

For American companies and workers, the growing importance of trade and the rise of strong foreign competitors creates both problems and opportunities The problems are centered around the fact that both America's basic and its newest, most advanced and most productive industries are targeted in the 1980s and 1990s by the cooperative government-industry labor combines of other industrial nations. Thus, many American companies and jobs are at risk.

Yet deepening involvement in the world economy also offers numerous opportunities for generating new wealth, income and jobs, but only if American business can become more competitive and workers better educated and trained and more productive

THE DEMOGRAPHIC FACTOR

Although the future of work, here and abroad, remains largely unclear, much is known about a key component of the future, the demography of the work force

We know that because the post-World War II baby boom is maturing at the same time that many older workers are choosing early retirement, the growth of the American work force is slowing dramatically This means that today's workers will constitute more than 85 percent of the work force in the year 2000 Although the aging of the work force will alleviate some of the problems of youth unemployment, it will increase the importance of retraining and adjustment for adult workers. Indeed, for at least the next two decades, employers will be forced to draw primarily from today's pool of workers to fill pressing job vacancies

We also know that the average age of workers is increasing. Specifically, the portion of the population aged 25-54—considered the high productive core of the work force—is growing. This vital segment of the population, which constituted 61 percent of the work force in 1970 and 66 percent in 1984, is projected to constitute 74 percent by 1990. This unique demographic advantage creates a rare national opportunity for greater productivity, but only if the skills of American workers are kept abreast of the demands of their jobs.

Another key demographic fact that we now know is that women will be the major source of new workers in the American economy for the next ten years Almost one million additional women will enter the work force each year for the balance of this decade. Until 1995, they will comprise two of every three entrants.

Moreover, women are prepared for much more than traditional low-paying "women's work" such as retail sales or clerical jobs. Increasingly, women are as well trained for work as their male counterparts, or better trained Since the late 1970s, more women than men have enrolled in college Women are now awarded half of undergraduate degrees, and the overwhelming majority of female college graduates enter the labor force.

Equally significant, a growing number of women are rejecting traditional areas of study, such as literature, social sciences, and elementary and secondary education Instead, many are earning degrees in areas once almost totally dominated by men. Between 1970 and the mid 1980s, the portion of engineering degrees earned by women increased from less than 1 percent to almost 11 percent, the share of women medical school graduates leaped from 8 to 25 percent, and the portion of law degrees awarded to women rose from 5 to 33 percent These shifts indicate that women are deeply committed

to their careers and are likely to remain in the work force for most of their lives. This is a new reality for employers and educators alike.

Perhaps the most far-reaching co sequences of demographic change will be found in the shifting distribution of younger and older workers. The decline in the number of young people portends shortages not only in the military but in the civilian labor force as well. In fact, many businesses are sure to find themselves competing with the armed services for entry level workers, and educators will be forced to concentrate increasingly on adult education

But the aging of America will have its most dramatic—and potentially most disruptive—effects as workers retire in the early twenty-first century Already, for the first time in history, there are more Americans over sixty-five than teenagers.

As the number of young people entering the work force declines and the number of elderly Americans increases, there will be growing pressure for people to continue working once they reach retirement age. However, this will require a major reversal of attitudes and policies by employers.

The American Society for Training and Development reports that few employers adequately educate their executives on how to best manage workers as they move through their forties, fifties, sixties, and beyond

Faced with discrimination and inadequately prepared to find work or meet the challenges of new jobs, older workers are more than twice as likely as younger ones to give up searching for a job In 1984, nearly 330,000 older displaced workers had stopped looking and were no longer counted as unemployed

For these and other reasons, older workers are retiring early. While 33 percent of men aged sixty-five and over were working in 1960, only 16 percent were employed by 1984.

Almost half of these workers retire voluntarily, they are neither in failing health nor being forced out of their jobs because of mandatory age requirements. Some are retiring because of limited opportunities, others to escape dehumanizing work environments, and still others because their skills are limited or they no longer find work satisfying.

Yet the Labor Department reports that workers over forty—those legally defined as older under the Age Discrimination in Employment Act—are as productive as their younger counterparts, and even more so in most occupations. Enticing older workers to stay on the job and assuring that they are equipped with state-of-art skills is a major means to meet the nation's long-term employment needs.

THE ARITHMETIC OF CHANGE

Jobs and worker flexibility are the keys to the great economic change that is transforming work and life in the United States. If enough jobs can be created for all who wish to work and if all who wish to work can be prepared for these positions, then new technologies can be introduced quickly and U. S. involvement in the global economy can be expanded But if the nation cannot meet the challenge of job creation or cannot help workers secure the lifetime education and training they will require, trade protectionism and resistance to change are certain to escalate, regardless of long-term personal, national, or global consequences.

This turbulent economic metamorphosis, therefore, is likely to be dominated by two pivotal questions. Can the U. S. economy produce enough jobs for all Americans who wish to work? Can today's workers be prepared for tomorrow's jobs?

The answer to both questions is yes. Whether there are enough jobs depends on how many people want them and the ability of the economy to produce them. We can now see that because of the maturation of the baby boom generation, the job-creation challenge will be far less formidable in the future than it was during the past quarter century, when the U. S. economy produced more than forty million new jobs.

The Bureau of Labor Statistics, using a set of moderate assumptions, predicts that between 1984 and 1995 the American economy will create almost 16 million new jobs, enough for virtually all who wish to work.

What will be different in the future is that most of these new jobs will come from small business and entrepreneurs. In the 1950s and 1960s, big business and expanding government generated 75 percent of all new employment. But the surge of entrepreneurship, coupled with a slowdown in the growth of government, has changed this pattern. David Birch of MIT estimates that small business is now creating more than 70 percent of all new jobs.

This fundamental shift in the economy is critical to educators since large business conducts most of its own training, while small firms and entrepreneurs have traditionally looked outside their organizations when they need to educate and train their workers.

Another important consequence of these shifts in the economy is that workers face the prospect of occupational obsolescence and displacement. Workers can already expect to change occupations three times and jobs six to seven times during their careers. This high rate of occupational and job mobility will increase as the speed of change accelerates and its scope widens.

IMPLICATIONS FOR EDUCATORS

The United States faces a future in which the shift to the technologies, production processes, and management styles of the twenty-first century will proceed with few certainties and in an environment of fierce, often predatory, global competition. The most practical way to confront the challenges of rapid, uncertain, unrelenting change is to improve the nation's ability to adapt to the future, whatever it brings.

If America is to adjust successfully in the years ahead, it requires workers who can secure training, find jobs, be productive, advance and shift between jobs and occupations with ease and confidence.

Improving the flexibility of American workers requires many actions—creating personal, portable pensions; eliminating work-related discrimination, and providing safe, convenient, affordable child care services.

Equally important, virtually all workers will need "booster shots" of education and training throughout their careers. The United States requires a comprehensive adjustment and training strategy to boost the skills of its workers, preparing them for a lifetime of change in the workplace. There must be ways and means to provide remedial education and pre-entry level training for disadvantaged and impaired workers, entry-level training for more than a million new workers coming into the labor force each year, continuing training and education for the vast majority of workers who will need a lifetime of skills improvement, and retraining and adjustment assistance for the 2 million people who are displaced from their jobs each year.

Just as American educators played a pivotal role in helping the nation shift from an agricultural to an industrial economy, they now are key participants in helping American workers shift from today's to tomorrow's economy.

If education, particularly vocational educators, are to play this role, special attention is required to several pivotal issues.

The first is the need for a comprehensive approach. Today education and training programs are heavily concentrated on a small portion of the population, most of whom are young or disadvantaged. While attention to these groups is unquestionably needed, most adults and employed workers will also require additional education and training Thus, training policies must be expanded to encompass the needs of the entire American work force.

Financing is another issue In the present era of limited financial resources, greater investment by employers is required Today, public policy discourages such investment. Although there are three principal factors of production—capital, technology, and work force performance—the federal government provides incentives for investment in only capital and R&D. The lack of comparable incentives for investment in worker performance reinforces the bias of most firms

against training and retraining Investment in technology and modern machines becomes the property of the firm, while improved worker skills do not. Greater employer investment in training skills can be stimulated by either eliminating the incentives for capital and R&D or establishing comparable incentives for worker training.

Finally, a clear allocation of responsibilities is required. Today, responsibility for training is haphazardly allocated among public institutions, business, labor unions, government agencies, and private community organizations. This needs to be sorted out so that obligations—and resources—reside with those who are best prepared to meet them

In sum, America's success in meeting the challenges of swift, far-reaching, uncertain change depends primarily on how well we develop and apply the knowledge, skills, wisdom, enthusiasm, and versatility of the nation's prime resource, the American people.

RECOMMENDATIONS

1 Strengthen the customized training programs of states through. (a) new tax incentives to stimulate more private-sector donations of monies and training equipment, (b) state-owned and operated pools of training equipment that can be moved from school to school, (c) cooperative equipment-sharing arrangements with private firms, (d) incentive pay plans to encourage faculty upgrading, and (e) public training programs that are linked to identified needs of employers.

2 Create a Block Investment Credit (BIC) that would equalize federal tax treatment of investments in machinery, R&D, and worker training.

3 Create Individual Training Accounts for displaced workers—a venture-based displaced worker training program modeled on the GI Bill with self-financed, savings-and-equity-based financing analogous to the Individual Retirement Accounts (IRA).

4 Reform the unemployment insurance system so firms that give advanced notification of plant closings pay lower payroll taxes than those that close with little or no notice.

5 Reform the unemployment insurance system so tax collections are based on a company's record in contributing to unemployment

6. Release the one billion dollars of payroll taxes the federal government levies on employers to operate the state job service and use these monies to. (a) modernize testing and counseling services, and (b) computerize data exchange so the job service can better match workers seeking employment with employers seeking workers.

7. Establish local child-care information and referral services and provide federally funded child-care vouchers for low- and moderate-income families with mothers who work.

TECHNICAL AND COMMUNITY COLLEGES: CATALYSTS FOR TECHNOLOGY DEVELOPMENT

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This paper identifies the two-year college emerging as the institution best suited to bridge the gaps between theory and practice, research and commerce. Change is in order to bridge the gap—a change in the curricula and internal structure of the educational programs of two-year colleges A new mission is in order—a mission that addresses not just human resource development but economic development. Rosenfeld thinks it is time for states to re-examine the ways their schools are organized and funded to see if they have the flexibility needed to effectively serve their communities, states, and regions.

Executive Summary "Technical and Community Colleges: Catalysts for Technology Development" by Stuart A. Rosenfeld

State and local officials are beginning to comprehend the growing importance of technology, education, and information to job formation, increased productivity, and economic development. They are depending on two-year colleges to provide technical skills for the growing number of occupations that require more than the basics but less than a baccalaureate. More and more, they are depending on them for technical assistance to small businesses The two-year college is emerging as the educational institution best suited to bridge the gaps between theory and practice, research, and commerce.

Two-year colleges are aware that they must redesign their curricula and the internal structure of their educational programs to better fit anticipated changes in the workplace. By so doing, they will create a new mission that provides the economic context for high-quality technical education and addresses not just human resource development but economic development

The number of schools taking on this new mission is still quite small and the number doing it effectively is still smaller. This paper presents a legislative history of the development of two-year colleges and examines some innovative ways that they are contributing to the development, application, and use of new technologies

As far back as 1961, the vocational education system was charged with meeting both industrial and military needs. It was concluded, at that time, that advancing technology was causing many jobs to require more technical proficiency and a greater knowledge of mathematics and science Also, jobs often required a more mature person than high school age youth In 1963, postsecondary schools became unequal partners in vocational education as the elementary and secondary school education agencies retained control of the federal funds and programs The postsecondary schools' curricula became more vocational but not necessarily more technical

In the 1960s and '70s, state economic development efforts were predominantly industrial recruitment. Customized training for industry became the goal The ultimate measure of success was value to the employer, not the employee Critics called this effort a zero-sum strategy because it was based on recruiting jobs rather than creating jobs

It took a rapid contraction of labor-intensive manufacturing in the 1980s due to foreign competition to bring about changes in the structure and mission of technical colleges. Employers in emerging industries demanded higher and more flexible skills than those that could be provided in short-term, customized training.

As two-year colleges have always been the first educational institution to be called on to react to technological change, they have become more responsive to changing labor market needs than any other public educational institution. Their mission already includes economic development allowing them to focus their efforts on meeting and balancing the employment needs of the individual and the development needs of the local economy

Today the technical colleges are becoming a catalyst for economic development and growth. Their principal function is still to provide individuals with marketable skills but much of their

activity centers on the application of new technology. Community colleges and technical institutes are becoming holistic technology resource centers who educate, facilitate, and broker technology transfer They are becoming independent of other educational agencies, obtaining increasing support from economic development agencies, economic development legislation, and the private sector for their financial resources and organizational strength. They are evolving from vocationally oriented postsecondary schools to comprehensive technical resource centers.

The rapid pace of technological change and rising costs of keeping up with the latest advances in equipment and methods are causing technical colleges to become more selective about programs for which they can maintain high standards. A college has to identify its technology niches and concentrate its resources At the same time, potential and expanding businesses expect more help at each stage of the new business of the product development cycle planning, research and development, funding, marketing, and training.

This paper explains and illustrates current models being used by two-year colleges that allow them to provide a more diverse and extensive array of services for new and expanding businesses as well as continue a technology focus. Models and services discussed are. (1) technology resource centers; (2) partnerships; (3) technology transfer, (4) technical assistance, (5) brokering, (6) new business incubators, (7) research, development, and testing, and (8) high-tech learning environments.

To assist the facilitation of technology transfer, colleges are revising and revitalizing their (a) technical associate degree programs, (b) skill upgrading programs, which include but go beyond customized training; and (c) continuing education, which ranges from adult literacy to management seminars and highly technical courses for graduate engineers.

The technical associate degree program had to be revised as potential technicians can no longer acquire what they will need in twelve years of formal schooling. Skill upgrading programs were revitalized to promote technology advances and economic development. The best antidote to technical obsolescence is continuing education, and the colleges and universities, which are able to stay abreast of technological changes are best prepared to be providers. Continuing education for other faculty and instructors from other schools as well as for local businesses is a high priority of the technical colleges.

Recommendations suggested for future deliberation were. (1) states should reexamine the ways their schools are organized and funded to see if they have the flexibility needed to effectively serve their communities, states, and regions, (2) pinpoint opportunities that lie in bridging the chasms that still exist between education and economic development, particularly in rural areas that lack sophisticated technological infrastructures, (3) continue to review existing programs to be sure that the balance between the educational mission and that of the new economic development goals stays in check, (4) determine if anything can be done to encourage the passage of Part D of the Carl D Perkins Vocational Education Act of 1984 that is explicitly intended to support the kinds of technology transfer activities technical colleges are undertaking, (5) study the need for target programs for women, (6) continue to review programs for remedial training, and (7) discuss the possible need to enroll and educate the increasing number of nontraditional students. The implications for vocational education are immense. There is little doubt that technical colleges will play a larger role in technology-based development in the future.

TECHNICAL AND COMMUNITY COLLEGES: CATALYSTS FOR TECHNOLOGY DEVELOPMENT

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TECHNICAL AND COMMUNITY COLLEGES: CATALYSTS FOR TECHNOLOGY DEVELOPMENT

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In November 1986, more than 11,600 people came to the convention center in Greenville, South Carolina, to see and discuss the most advanced manufacturing technologies. Vendors, manufacturers, college faculty, and students from Florida to California mingled about 224 exhibits that represented the latest advances in automated equipment for the factory floor, exchanging ideas, information, and business cards Ray Marshall, Lester Thurow, and Governor Dick Riley were only a few of the featured speakers. The event, **AM86: Man and Machine, The New Partnership**, was sponsored, arranged, and hosted by four of the state's technical colleges, part of their growing efforts to introduce the latest technologies to the states' industries, to make sure that there are people educated to use them effectively, and to showcase South Carolina's technology transfer capabilities. Some might be surprised to find two-year colleges putting together a program as technically sophisticated as **AM86**. Not only did **AM86** happen, even more successfully than anticipated, but equally sophisticated programs by two-year colleges to encourage technology transfer are taking shape in all parts of the country.

INTRODUCTION

A decade or more ago state economic development policy generally meant industrial parks, revenue bonds, and tax abatements. Technology was known to be important to growth but was considered outside of the purview of state government Today, however, state policies are rapidly being redesigned as economic development policy as state and local officials begin to comprehend the growing importance of technology, education, and information to job formation, increased productivity, and economic development. These officials realize that public policies can be used to facilitate technology advances and transfers, but they are still exploring their options and searching for the most promising programs.

Most new state efforts to build on technology depend in one way or another on education and educational institutions. States look to their research universities to provide scientific and technical expertise and research, to their public schools to provide youth with the knowledge and attitudes that later will allow them to produce and use technology, and to their two year colleges to provide both technical skills for the growing number of occupations that require more than the basics but less than a baccalaureate, and technical assistance to small businesses.

Each tier plays a critical role in technological growth. There are constraints, though, on just how much priority educational institutions can and ought to give to economic goals, when contrasted to their basic mission of education Further, there are structural barriers. Public high schools are unable to adapt very quickly to changes in local labor market needs caused by technology, universities are accessible to too few communities and often too removed from the needs of small businesses (although there is growing support among four-year colleges for involvement in local development) The two-year college, however, as the "new kid on the block" may be the institution least constrained and best positioned to bridge the gaps between theory and practice, research, and commerce With more flexibility in faculty hiring decisions than either high schools or universities, two-year colleges may be best able to respond quickly to changes in occupational demand and advances in technology.

Most colleges in the nation are not yet taking full advantage of their opportunities to stimulate growth And many may not wish to rearrange their priorities to include economic development. But in other places the technical college already has become both the major conduit for technological advances and the glue that binds together the various components of a comprehensive technology-based development program the research and development that leads to new products and processes, the employers who will invest in and apply the technologies, and the employees who must be able to use and understand them [1] Dr Karl Jacobs, president of Rock Valley Technical College in Illinois, has succinctly stated the newest position of the colleges.

> Community colleges can make a major contribution to the transfer of technology by bringing together area businesses and outside resources We have the infrastructure to provide the arena and the networking systems to bring people together This is especially important for smaller manufacturing operations because they cannot leverage the information on their own.[2]

The full extent to which the technical college can become an instrument for technological progress is only now emerging Across the country, technical colleges are experimenting with new and innovative programs to discover just how they can best contribute to technology-based growth

A 1986 survey of technology transfer activities at 254 institutions of higher education conducted for the Appalachian Regional Commission illustrates the extent to which technical colleges are becoming involved in technology transfer [3] Fifty-one of the 103 responses to the survey

1 To avoid confusion, two-year postsecondary institutions will be called "technical colleges" throughout the paper unless reference is made to a particular school

2 Laura Taxel, "Community colleges taking a major role in shaping region's economic renewal," **mid American Outlook**, 8 (Spring 1985).

3 Analysis of data by Louis Blair, Falls Church, Virginia, based on his report prepared for the Appalachian Regional Commission, **Strategies and Approaches for Appalachian High Educational Institutions to Diffuse Technology for Regional Economic Development,** December 1986.

were from two-year colleges The results showed not only that the two year colleges are providing a wide range of services but that they are actually providing a greater array of services than the four year colleges. For example,

- 84% of the two-year schools solve technical problems,
- 67% train managers to use technology;
- 65% have partnerships with industry to diffuse technology;
- 47% provide special assistance to entrepreneurs to use technology; and
- 43% provide some type of infrastructure support, such as incubators or innovation centers.

When asked how important technology diffusion is to their mission

- 62% believe that clearly defined roles and missions in technology diffusion are "essential",
- 55% replied that an office or center dedicated to technology diffusion is "essential", and
- 52% believe that funds to subsidize technology diffusion services to small firms are "essential."

Although there are no comparative data for an earlier time, it is safe to say that the activities mentioned are relatively new activities at technical colleges.

Technical colleges also are redesigning their curricula and internal structures of their educational programs to better fit anticipated changes in the workplace As Robert Reich asserts in his latest book, *Tales of a New America*, "To compete on the basis of rapid improvements in product and process, rather than on the basis of the scale economies of mass production, means a new emphasis on the innovative skills of workers—the productive services they deliver—and on the organizational structure of production."[4]

The reorientation of the technical college to actively encourage and support technology-based growth rather than react to change may well prove to be its most important new mission, one that provides the economic context for high quality technical education and addresses not just human resource development but also economic development. **The number of schools taking on this new mission, however, is still quite small and the number doing it effectively is still smaller.**

There are valuable lessons to be learned, which generally can be replicated elsewhere, from those colleges that have successfully integrated their new mission with their educational goals. **These lessons are particularly important to rural areas, which may have few other sources of technical nonagricultural education, expertise, and information.**

4 Robert B. Reich, **Tales of a New America** (New York: Times Books, 1987).

This paper examines innovative ways in which states' public technical colleges contribute to the development, application, and use of new technologies. There is still a great deal of "hype and hope" concerning the true effectiveness of any institutions in technology transfer, including the technical colleges. Descriptions of programs reported in this paper were impressionistic. Because they are still so new, their successes have been accepted *a priori* and their true value can only be measured over time. But even if the innovative programs yield half of what they promise, they portend to be wise investments in economic development.

THE ROAD TO UNIVERSAL POSTSECONDARY EDUCATION: THE HISTORICAL DEVELOPMENT OF THE TECHNICAL COLLEGE

The history of the two-year postsecondary school, the latest of the nation's public education institutions to reach maturity, is a story of a search for an identity. Even the name of the institutions has been a source of confusion, two-year schools are called community colleges, junior colleges, technical colleges, technical institutes, vocational-technical centers, or simply colleges.

For the first half of this century, the goal of public two-year colleges was to make community-based postsecondary education, "people's colleges," available to the large share of the youth population who were not pursuing a baccalaureate degree.[5] The first surge of growth occurred during the Depression when, for financial reasons, students had to remain nearer their homes and attend less expensive schools. Two-year colleges were both terminal institutions of higher education, providing a credential for semiprofessional or paraprofessional occupations, and transitional institutions providing an entry into baccalaureate programs for students not rich enough or not well-prepared enough to directly go to a university from high school.

Critics, however, have labeled two-year junior colleges pale imitations of four-year colleges, failing to live up to their claims of providing increased semiprofessional job opportunities for low-income students. They became a safety valve on pressures to educate lower-achieving students.[6] In 1941, 75 percent of a large sample of educators and administrators believed that the terminal function of the two-year college was much greater than its preparatory (for college) function.[7]

Sputnik, more than any other single event since World War II, piqued public interest in technology and in improving technical education, and it eventually reshaped the nation's two-year colleges. Public policy moved swiftly to alleviate the nation's shortage of technicians and Congress

5 Charles R. Monroe, **Profile of the Community College** (Washington DC: Jossey-Bass, Inc., 1972).

6 Fred L. Pincus, "The False Promises of Community Colleges: Class Conflict and Vocational Education," **Harvard Educational Review**, 50 (3, 1980).

7 David O. Levine, **The American College and the Culture of Aspirations, 1918-1940** (Ithaca: Cornell University Press, 1986).

passed the National Defense Education Act of 1957 That bill included an amendment to the federal vocational education legislation that authorized funds for area vocational centers to deliver technical education. Vocational education up until that time was a high school program, and technical education was offered either in the high school or in the growing number of proprietary programs often found advertised on bus panels, matchbook covers, and the back pages of popular magazines The two-year colleges had lobbied for federal vocational education funds and legitimacy as vocational educators since 1937 without success.

In 1961, President Kennedy convened a Panel of Consultants on Vocational Education and charged it with recommending changes in the vocational education system to better meet both industrial and military needs One of the conclusions of that Panel was that

> Because of advancing technology, many jobs require more technical proficiency and greater knowledge of mathematics and science. These jobs also often require more mature persons than youth of high school age As a result, attention is increasingly focused on postsecondary vocational and technical education.[8]

As a result of the Panel's report, new federal legislation passed in 1963, providing a **second wave** that radically altered the structure of vocational education. The result was that postsecondary schools became partners, though not equal partners, in vocational education In most states, elementary and secondary school education agencies retained control of the federal funds and programs, doling out the prescribed set asides to postsecondary schools

The law also established new occupational areas including one called Technical Occupations, which was offered almost exclusively in postsecondary institutions The postsecondary schools' curricula did become much more vocational, but not necessarily more technical In 1979, only 15 5 percent of all postsecondary students were enrolled in technical occupations and less than one in five of those was female The greatest occupational demand, however, was still for nontechnical occupations and that's where most postsecondary institutions put their resources In 1982-83, the last school year for which the U. S. Department of Education released the information collected in the Vocational Education System, only 11 percent of all postsecondary enrollments were in the technical program areas that are most explicitly technology related. Communications Technology, Computer and Information Sciences, Engineering and Related Technologies, and Science Technology Further, only eight percent of all postsecondary completers were in those four categories

As technical colleges became more vocational many of the complaints that were lodged against high school vocational education were transferred to the colleges, including the charge that postsecondary vocational education represented tracking mechanisms to "cool out" the aspirations of

8 Panel of Consultants on Vocational Education, Education for a Changing World (Washington DC. Government Printing Office, U S Department of Health, Education, and Welfare, 1963) p. 230.

lower class youth The fact that the two-year schools were postsecondary simply made the tracking seem all the more insidious Youth believed they were getting a "college" education that would open doors in the labor market, but in reality there was little to distinguish many of the postsecondary programs from high school vocational education programs, and their graduates did not fare much better in the job markets An analysis of program enrollments in southern states prepared in 1980 for the Southern Growth Policies Board[9] showed that the majority of postsecondary enrollments were in programs that are also considered high school programs—secretarial occupations, auto mechanics, and typing.

With the success of the U.S. space program and fading fear of Russian space superiority, and with automation arriving more slowly than predicted, postsecondary vocational education turned its attention to industrial growth State economic development efforts in the late 1960s and 1970s were predominantly industrial recruitment, and states, particularly in the South, began to use their two-year college systems to deliver customized training for industry

Some states, e.g , North and South Carolina and Oklahoma, began early in the 1960s to tailor programs to the specific needs of new plants These programs were short-term, explicitly aimed at facilitating economic development, and they usually led to employment. The goal of customized training, however, was to minimize industry's start-up costs, not necessarily to provide individuals with transferable and marketable technical skills The ultimate measure of success was value to the employer, not the employee The technical college became part of an industrial recruiting strategy, but one which critics called a zero-sum strategy because its goal was to recruit jobs rather than create jobs There were high quality technical programs in the nation, but they were not abundant.

It took a rapid contraction of labor-intensive manufacturing in the 1980s due to foreign competition to bring about changes in the structure and mission of technical colleges Employers in the emerging industries demanded higher and more flexible skills than those that could be provided in short-term, customized training.

Technical colleges have undergone many changes in structure, curriculum, and mission since the early part of the century. As mentioned previously, the weakness of their historical grounding, and school culture, and entrenched vested interests also are its strengths. These factors enable technical colleges to be more responsive to changing labor market needs than any other public educational institution And because the missions of the technical colleges include economic development, they can focus their efforts on meeting and balancing the employment needs of the individual and the development needs of the local economy

[9] Southern Growth Policies Board, **Setting Goals for Vocational Education**, Report prepared for Executive Committee Meeting, Atlanta, Georgia, Governor George Nigh, Oklahoma, presiding, June 1, 1984

THE THIRD WAVE: NEW ROLES IN TECHNOLOGY DEVELOPMENT

Today the technical college is entering a third phase, moving from **serving as an important but passive ingredient of economic development to becoming a catalyst for economic development and growth**. The principal function of the school is still to provide individuals with marketable skills, but schools are adding an impressive variety of new and innovative functions to revitalize businesses and expand the number of jobs. Much of this activity centers on the applications of new technology. Community colleges and technical institutes are becoming holistic technology resource centers, not only educating individuals to use and understand technology in the workplace and to make decisions regarding its use but facilitating and brokering technology transfer in ways that are as innovative as the technological advances themselves.

New Partnerships: Governance and Structure

As the purposes and functions of the technical colleges have changed, so have governance and structure. Technical colleges are becoming independent of other education agencies in more states and are obtaining increasing support from economic development agencies, economic development legislation, and the private sector for their financial resources and organizational strength. The institutions themselves are evolving from vocationally oriented postsecondary schools to comprehensive technical resource centers.

State Organizations

The organization of technical colleges at the state level varies considerably from state to state. If there is a trend, however, it is toward greater autonomy, more fiscal independence, and more collaboration among colleges.

Both policy and administrative authority in most states rest with the agencies responsible for higher education. In eight other states, however, the Board of Education or Department of Public Instruction runs the technical colleges and five states have Boards of Vocational Education or their equivalent with responsibility for two-year schools. Five states have set up independent Boards of Community Colleges to set policy for the schools, and eight states have Boards of Community Colleges to administer schools' programs.

Despite the growing recognition of these colleges' roles in technical education, they still have trouble competing for educational funds. In North Carolina between 1973 and 1983, technical college enrollment increased 89% while state per-pupil funding declined 27% in constant dollars. Half of the states in the country depend in part on local taxes to support their technical colleges, and technical colleges have been left behind in many states' education budgets. Consequently, some have had to rely on innovative funding—which may have been a blessing in disguise because it opened doors to new economic development functions. In many states, technical colleges look to departments of

economic development to support program improvements In Iowa, for instance, the Department of Economic Development established a network of Regional Satellite Centers and designated the technical colleges as those centers Most of the customized training programs and many of the new technology resource centers are funded through state economic development programs.

States with formal technology programs generally include their technical colleges In Ohio, the technical colleges are part of the state's Thomas Edison Program, and in Pennsylvania, the colleges are an integral component of the Ben Franklin Partnership Programs. Pennsylvania's four advanced technology centers collaborated with community colleges on 23 separate technology development projects in 1986-87.

Technical colleges are also increasingly willing to collaborate with each other—even across state borders—to be able to provide high quality programs or services in support of technology development. For example:

- four colleges in South Carolina jointly organized a regional automated manufacturing show, AM86;
- a consortium of four colleges conduct training under Western Pennsylvania's Advanced Technology Center,
- four different colleges in New Jersey support a sophisticated Computer Integrated Manufacturing Center; and
- ten colleges located in Iowa, Wisconsin, Illinois, Michigan, and Ohio form the Mid-America Technology Training Group, a systematic network for comprehensive technical training and information exchange

Technology Resource Centers

Technical colleges are rearranging themselves internally as well as externally, in ways that at first blush may seem inconsistent The rapid pace of technological change and rising costs of keeping up with the latest advances in equipment and methods are causing technical colleges to become more selective about programs for which they can maintain high standards To be a source of technical knowledge, expertise, and innovation, a college has to identify its technology niches and concentrate its resources At the same time, potential and expanding businesses expect more help at each stage of the new business or product development cycle. planning, research and development, funding, marketing, and training. Thus colleges must provide a more diverse and extensive array of services for new and expanding businesses at the same time that they are expected to be more focused technologically.

An increasingly popular model is the technology resource center, which operates within the structure of the technical college but may actually be administered and run as a separate operation. It draws students from outside the normal attendance area, attracts private sector dollars, is highly sought by business and industry as a source of information and applied technology, conducts applied

research and development for business, and generally provides skill upgrading as well as awarding associate degrees The centers feature state of the art equipment, maintain close ties to university research centers, have support from industry and have close links to employers, who use the facility to retrain their own employees, to train new technicians, and as a laboratory to test new processes and procedures

These technology resource centers are to the technician what the top-rate universities are to the scientist or engineer. South Carolina has taken the most systematic and comprehensive approach. The state has established eight major centers, the Robotics Resource Center at Piedmont Technical College, Advanced Machine Tool Technology Center at Greenville Technical College, a Microelectronics Resource Center at Tri-County Technical Institute, Computer Applications at York Technical College, Office Automation at Midlands Technical College; Electronic Mechanical Maintenance at Orangeburg-Calhoun Tech, Tourism at Horry-Georgetown Tech; and the Environmental Training Center (and Water Quality Institute) at Sumter Technical College While serving a local multi-county area, as the resources and reputations of the resource centers grow, they attract students from across and outside of the state

The second attribute of the technical resource center is the comprehensiveness and diversity of the services provided. Technical colleges no longer end their responsibility for economic development with education and training. Schools such as Moraine Valley Community College in Palos Hills, Illinois, and College of DuPage outside of Chicago serve as one-stop resource centers for prospective entrepreneurs and expanding businesses

The result of this new internal structure is that the technical colleges provide stronger support for local development but by specializing they also serve a much wider economic area The stronger the program, the greater the distance students will come to enroll. Of the 30 associate degree students admitted to the automated manufacturing programs at the Robotics Center at Piedmont Technical College in South Carolina last year, ten were local, ten were from the state but not the counties served by the center, and ten were from out-of-state

Partnerships

Partnerships are perhaps the most highly publicized strengths of technical colleges. Virtually all of the schools that have successfully stimulated economic development have strong ties to the private sector and to other educational institutions. The list is too long to present in this paper and the American Association of Community and Junior Colleges has an on going program called **Putting America Back to Work**, which highlights the most innovative and successful programs in the nation

One state-wide program that merits mentioning, however, is **Florida's Centers of Electronics Emphasis and Specialization**. Electronics is both one of the state's fastest growing industries and central to many of the state's other industries, such as aerospace. In 1983 the state

had more than 100,000 people employed in the electronics field, but industrial recruiters were dissatisfied enough with the quality of the electronics technicians graduating from the state's vocational programs to look out of state for technicians In response, Florida's High Technology and Industry Council and the postsecondary vocational education system collaborated to establish ten Centers of Excellence—five in community colleges and five in vocational-technical centers—that are intended not just to meet the stated needs of industry but to achieve excellence. The ten schools, which work together as a consortium under the coordination of the University of Florida, are expected to provide leadership and technical expertise to electronics education programs throughout the state and to encourage high-tech companies to locate and expand within the state.

SOMETHING OLD, SOMETHING NEW: INNOVATIVE FUNCTIONS OF TECHNICAL COLLEGES

Technical colleges are both doing new things and doing old things better They are supporting technology advances in ways that historically were not part of their missions while continuing to provide technical education and training. Their new agenda includes:

- facilitating technology transfer and providing technical assistance to entrepreneurs and existing businesses;
- operating technology business incubators;
- supporting research, development, and testing, and
- providing a learning laboratory that simulates the most technologically advanced work environment.

Old or traditional roles that are being revised and rethought, include.

- revamping the technical associate degree program in light of technological advances and new organizational styles,
- upgrading the skills of the present and new work force; and
- providing continuing education and professional development for supervisors and management.

The following are examples of some of the more innovative approaches that technical colleges are using to enhance both human resource and community economic development.

In 1985, two local people brought a concept to the technology transfer agent at the **Cuyahoga Community College** in northern Ohio. They found that fish are attracted to a hook by a luminescent chemical material—a high-tech fishing lure. The material could be inserted in any lure, but had a finite life and had to be replaced on a regular basis, creating a potentially high volume business. The technology transfer office of the college worked with the prospective business people to develop the compound they needed, to solve a contamination problem that had been plaguing them, to perfect the production process, and to put together an investment package. They used the resources of NASA, SBA, and private investors to get the business underway.

One of the most vexing problems facing American industry is the need to move new products and processes developed in the labs to the firm that can use them commercially. This technology transfer function has not been carried out very effectively in the past by any institutions or agencies Critical ingredients of a technology transfer system include an inventory of innovations, knowledge of the needs of business, and close ties to the community. The first is a technical problem that is quickly being solved with more accessible and more comprehensive databases. The second and third, however, require strong working relationships with businesses and the community.

Technical colleges have in many ways modeled themselves after the cooperative extension service, a federally supported county-level program that has served American agriculture so well for eighty years. The services that technical colleges are providing include formal networks of technology transfer agents who (a) maintain or have access to databases of technical information, (b) provide technical assistance on request, particularly to small businesses, and (c) broker agreements among agencies to solve technical problems.

Technology Transfer

South Carolina's State Board of Technical and Comprehensive Education (TCE) has made technology transfer one of its top priorities. According to a working document from the Board, "The reason community colleges have not assumed this role (technology transfer) has been their perception of their role in education." Taking on the responsibility for technology transfer would "expand our role to education in the broadest sense as purveyors of information, skills, knowledge, and techniques." The state uses the technical colleges to market the services of the Southern Technology Application Center (STAC) out of the University of Florida. The system contains over 1250 computerized databases, access to the Federal Laboratory Consortium and to NASA's field centers, and to consulting services through the University of Florida system

The state of Ohio also turned technology transfer into a statewide service by creating the **Ohio Technology Transfer Organization** (OTTO). Technology transfer agents are assigned to 28 sites, including 24 technical colleges In 1986, 32 OTTO agents working in the two-year schools helped start 118 new businesses and assisted 935 businesses in bringing new products to the market. Approximately 70 percent of the program's clients last year were businesses of fewer than 20 employees, 32 percent are manufacturing businesses, and 31 percent of the requests are for engineering or scientific assistance.

Virginia's Center for Innovative Technology is establishing a Technology Transfer Agent Pilot Program, funded by the General Assembly, in eight technical colleges The program objective is to deliver "specific technology transfer services to local business and industry by selected community colleges that contribute significantly to the economic stability and growth of the local area." The sites were selected on the basis of the concentration of businesses with advanced technologies or mature industries that could benefit from technological innovations, lack of access to a research university, and the college's commitment to exploring new and innovative roles

Technical Assistance

The technical college, which is the main source of technical expertise in many communities, is frequently called on for technical assistance by local planners and local business people. Last year, for example, South Carolina's eight technology resource centers responded to 351 requests for assistance from business and industry and 190 requests from other technical colleges, **The Fox Valley Technical Institute** in Appleton, Wisconsin, had 684 contracts with business last year and 25 percent of them were for direct technical assistance **Cuyahoga Community College** in Ohio handled 4,139 different requests from 2,790 companies in 1985.

One model for providing technical assistance through the technical college is the small business development center (SBDC) Though not limited to working with technology dependent businesses, many of the most promising clients do use or market new technologies. The state of North Carolina has set up SBDCs in 35 of its 58 community colleges and allocated $50,000 to each to provide for a director The SBDC at **Guilford Technical and Community College** is an example of the extent to which the colleges can encourage and support new business start-ups The center has provided assistance to a high tech manufacturer of aircraft blades, a word processing business, a programming service business, a firm that manufactures electronics boards to enhance x-rays, and a firm that builds electronic autoclaves used in medicine Services include developing business plans, linking business people to Small Business Innovation Research grants, export marketing firms, and sales representatives, training employees, and providing workshops for the business owners

Brokering

The state of Illinois is trying a technical assistance model with a somewhat different emphasis at a small number of its colleges. These colleges are primarily brokers of services in addition to providing education and training. The **Technology Commercialization Center** works with the prospective business to identify its needs and then bring management together with those who can provide the services, either inside or outside of the school. Although most of the centers are in universities or federal laboratories, the state has funded two in technical colleges. The center at the **College of DuPage** in Glen Ellyn provides one-stop technical assistance for technology related businesses that includes research assistance, feasibility studies, prototype development and product testing, patent applications, technical education, identifications of funding sources, and marketing assistance. By the end of January 1987, the new Center had served 17 clients, including developing six prototypes, applying for two patents, and working with six businesses in the early stages of an invention. One of the college's successes was a company that developed a technically advanced rewinding system for rappelling equipment used in mountain climbing. The College linked the potential business with the small business development center, research labs at the university to perfect the mechanism, and sources of funding to get the business off the ground.

The New Business Incubator

Three years ago the Fantus Company, after analyzing the economy of Wausau, Wisconsin, concluded that one of the area's major untapped economic assets was a two-year associate degree program in Laser Technology at the **North Central Technical Institute**. That technology, the company reported, could prove a valuable resource to new businesses if offered in conjunction with a supportive environment. The Institute, the city, the county economic development councils, the area regional planning office, the chamber of commerce, and a number of local businesses began plans to convert a vacant industrial building into an incubator for businesses that could use or benefit from laser technology. In spring of 1987 the incubator received a $775,000 grant from EDA to supplement the funds raised locally and the incubator was off the ground. Students from the laser technology programs and the small business management program will work with the new businesses wherever appropriate.

North Central Technical Institute is an example of a technical college working with the community for local development. The school modified an innovative and still experimental policy, the business incubator, to fit the structure of the technical college. A new business incubator provides a protective environment in which a new or expanding business can establish itself in the market at minimum expense, receive technical assistance, and in the case of new technologies, work out some of

the bugs before going into full production. It is one of the latest programs created to respond to the realization that small businesses, not large corporations, are the nation's largest source of new jobs

The **Noble Center for Advancing Technology** at Oklahoma State University's Technical Branch has developed a similar specialized incubator around technology in waterjet cutting, a computer positioned, abrasive, high-pressure stream of water Though not limited to that particular technology, the Center is trying to use the new technology to solve special needs of industry for cutting hard materials with minimal distortion. It is, for example, experimenting with the technology on various materials for several corporations, including evaluating the use of waterjet cutting to bore high tolerance holes for GM's Saturn plant.

The advantage of locating the incubator within a technical college, particularly for high-tech businesses, is that businesses have access to faculty trained to work with small businesses and familiar with new technologies, to advanced equipment, and to a technically trained work force It gives the students the exposure to the problems associated with technological change, new business start-ups, and provides opportunities for future employment. And it serves the community by supporting budding entrepreneurs or existing businesses that are embarking on expansions.

A number of other technical colleges have set up incubators in recent years **Des Moines Area Community College** in Iowa created the "Golden Circle Incubator" as a not-for-profit company for new or expanding businesses. The incubator is one of three in the state but the only one at a technical college: the other two are at state universities. Monthly overhead expenses for businesses in the incubator are less than half of what they would be in the private sector, and businesses are eligible to remain in the incubator for up to two years. The incubator gives priority to the most innovative applicants and two of three manufacturing businesses currently in the facility are what the director calls high-tech businesses

Niagara County Community College in Niagara, New York, also has opened a new incubator Its first client will produce a circuit board once manufactured by a large corporation but recently discontinued The company, started by one of the corporation's engineers, will combine the expertise of a Canadian company and an American company in Ohio to produce the board and market it both to the corporation that once produced it but still needs it, and to others The firm will use the electronics laboratories of the school for its R&D, the incubator as its plant, and students as staff to help develop a prototype of the production process. The Technical Assistance Center of the school, which has special state funding, will help the fledgling company find funding and markets

Rarely is an incubator an isolated activity within a college, those that provide incubators nearly always do it in combination with a broad range of services. The **Des Moines Area Community College**, for example, also provides consulting to businesses, a quality of work life institute, a computer literacy institute, a conference center, as well as technical training, the incubator in Wausau is part of the college's Technological Innovation Center, which provides an array of services to local businesses, and the incubator in Niagara is under its Technical Assistance Center

Research, Development, and Testing

In 1984, **Southwestern College** in Chula Vista, California, entered into an agreement with San Diego Gas and Electric Utility to serve as a test site for solar heating and a photo voltaic cells power supply. Students assembled, installed, and maintained the experimental units and recorded and analyzed data They discovered, among other things, that one solar panel was more efficient than two.

Nothing demonstrates the new scientific sophistication of the technical colleges and their students more than the willingness of industry to enter into agreements with two year colleges to experiment and test new processes and products At the same time that colleges contribute directly to technological advances, students learn first hand how to tackle technical problems and how to use their skills and knowledge in innovative ways The research generally responds directly to the practical problems associated with new or different production methods

Southwestern College's agreement with San Diego Gas & Electric to experiment with a new product is not an isolated example Students at a ceramics technology program at **Hocking Tech** in Ohio test and evaluate material submitted by industry on $500,000 worth of advanced equipment donated by industry. At the **Fox Valley Technical Institute** in Appleton, Wisconsin, Miller Electric has an on going arrangement with the automated manufacturing program to try out new processes, test equipment, and work on special projects For this, the company has provided equipment

The **Noble Center for Advancing Technology at Oklahoma State University, Technical Branch** in Okmulgee, Oklahoma, opened the doors of its multi million dollar facility in 1985 As the reputation of its programs and resources spread, businesses increasingly looked to the Center for assistance Recently one of a small number of companies that "re-manufactures" automotive parts asked the Center for help in solving some of the technical problems associated with rebuilding computerized automobile components The school will work with the firm to design a prototype testing procedure and develop standards In addition, the Center is using its waterjet cutting technology for experiments with a number of clients, including General Dynamics, General Motors, and the U.S. Navy.

Moraine Valley Community College in Palos Hills, Illinois, has a slightly different arrangement for contributing to industrial research. Rather than provide the R&D at the school, they link businesses that have technical problems to the scientific expertise of the Argonne National Laboratories. The school helps businesses establish cooperative R&D arrangements, get inventions or patents evaluated, and it provides consulting services to small businesses

High-Tech Learning Environment

In March 1984, **Chattanooga State Technical College** in Tennessee dedicated what was then believed to be the most sophisticated automation training center in any two-year college The three million dollar Center for Productivity, Innovation, and Technology housed advanced equipment that included flexible manufacturing cells, robots, CAD/CAM, and automated quality control units. The investment was expected to both revitalize local businesses and attract businesses that need help in staying on the cutting edge of new technologies. The Center's three-pronged mission, according to its director, is to educate associate degree students in state-of-the-art technology, retrain workers whose skills are being made obsolete by technology, and provide a laboratory for industry to help them solve technological problems

Applied laboratories that simulate advanced technical workplaces are proving to be invaluable to technical education and to the technologically advanced manufacturer This environment, once prohibitively costly, now is affordable because the private sector and the state increasingly recognize its value as an investment. Nearly every state-of-the-art college laboratory has equipment or funds for the purchase of equipment donated by the private sector and some special funding from state legislatures. In return, the school may provide the company with access to the facility for development and training and provide the state with jobs. Each of the eight centers in South Carolina described earlier has a technologically advanced lab that simulates an advanced workplace but is designed for learning.

The **Camden County College** in New Jersey, with support from the state's Jobs, Science, and Technology Bond Act of 1984, is constructing a $4 3 million facility to house an advanced Computer Integrated Manufacturing (CIM) program The three objectives of the center, according to director John D'Alessandro, are to educate a technical work force, conduct research on industries' needs for advanced manufacturing, and provide non credit continuing education to upgrade manufacturing skills When complete, the facility will include six automated manufacturing centers and serve six technical colleges in the state Students can pursue technical associate degrees by taking the first year of courses in their home schools and taking the second year at the Camden County College

As the centers begin to pay off, states become more willing to invest The state of Ohio provided $5 4 million for the construction and equipment of an Advanced Technologies Center at the **Lorain County Community College** outside of Cleveland It is intended to provide an advanced training facility, serve as a technology transfer center, and provide a library of technical information Industry already is taking advantage of the facility and providing equipment. Cincinnati Milacron, one of the nation's largest producers of industrial robots, uses the Center to demonstrate its products to customers, while at the same time training students.

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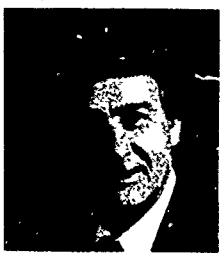

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TRADITIONAL MISSIONS AND NONTRADITIONAL METHODS

As the colleges act to facilitate technology transfer, they provide a source of and environment for educational opportunities that improve the technical education of the students Colleges have revised and revitalized their (a) technical associate degree programs, (b) skill upgrading programs, which include but go beyond customized training, and (c) continuing education, which ranges from adult literacy to management seminars and highly technical courses for graduate engineers

Educating the Renaissance Technician

At the Robotics Center at **Piedmont Technical College in South Carolina**, students in the Automated Manufacturing Program take courses in Sensor and Systems Interface, Workcell Design, Robotics System Operation, and Numerical Control Manufacturing in addition to the more basic courses in scientific and mathematical concepts. The latter must include at least one unit of calculus, two of algebra and geometry, three of physics or chemistry, and writing and communications The program was designed on the assumption that the industrial workplace is changing and that individuals need strong communications and problem solving skills and must be prepared for interdisciplinary work, all of which require stronger fundamental skills.

One of the major forces driving changes in the technical colleges is the demand for technically trained workers who have not only the skills to use new equipment but the ability to understand the equipment and its place in the total manufacturing operation They must be able to respond swiftly and independently to the inevitable problems that occur whenever programmed technologies replace craft and experience With modern technology and management methods and more fully integrated production systems, business relies more on its nonprofessional staff than ever before

This is a departure from the past when the title, *technician*, implied a high level of specialization. Modern businesses seek the individual who, in addition to technical competence, is able to understand how the entire production and business systems fit together, can tackle complex technical, systemic, and interpersonal problems, can contribute to more effective use of new technology, and is able to adapt to change In other words, businesses that depend on technology want the modern equivalent of the **Renaissance Man or Woman** [10] Unlike the Renaissance Man of

[10] Stuart A Rosenfeld, "The Education of the Renaissance Technician Postsecondary Vocational Technical Education in the South," **Foresight 4**, (Fall, 1986), Research Triangle Park Southern Growth Policies Board

the fifteenth and sixteenth centuries who *could* acquire a wide range of skills and diverse knowledge because the world was *simpler*, the Renaissance Technician of today and tomorrow *must* acquire broader-based skills and knowledge because the world is more *complex* and changing more quickly To the original Renaissance Man, diversity and adaptability were luxuries, to the Renaissance Technician they are necessities, critical to the modernization of the economy

The implications for vocational education are immense. Potential technicians can no longer acquire what they will need in just twelve years of formal schooling As high schools concentrate more on providing the fundamentals needed just to become technically competent, the technical colleges will have to complete the education of the Renaissance Technician

The best way to do that is by providing a less specialized curriculum in an environment that challenges the ingenuity and problem-solving ability of the student. A number of technical colleges are revamping their programs to provide just those opportunities for students. A recent proposal for curriculum reform submitted by the **Technical Branch of Oklahoma State University** at Okmulgee states.

> To assure meaningful employment opportunity and to insure against early occupational obsolescence graduates from all technical programs need to possess a broader understanding of the applied sciences and technologies relating to their specialization At the very least, they need an awareness that assures an understanding of the concepts, technical vernacular, and relationship (past and potential) to their technology And these graduates while students must have been challenged to listen, read, interpret, analyze, synthesize, and communicate their findings and conclusions in logical, meaningful terms Ideally, they will also possess a business-economic acumen and "people skills" to enhance their success as supervisors, and in managerial positions [11]

One of the consequences of increased skill and knowledge requirements of the workplace is improved coordination with both lower and higher educational institutions. The term "2 + 2," which refers to a program in which the last two years of high school are designed to prepare students for two-year associate degree programs, is becoming more popular and more common But the natural extension, the "2 + 2 + 2," with the technical college curriculum articulated with a bachelor's degree program is now beginning to gain some support **Williamsport Area Community College** in Pennsylvania has such an agreement with Rochester Institute of Technology giving students the option of transferring into a four-year program after receiving an associate degree **Southwestern College** has a similar arrangement with San Diego State University in California, and Oklahoma State's Technical Branch is recommending the same

[11] Oklahoma State University Technical Branch, **Proposal for Curriculum Reform**, February 16, 1987

Retraining and Upgrading Skills

As automation transforms manufacturing in the South, more and more of the workers will be required to understand the microprocessors that control the equipment. The **Applied Microelectronics Center for Innovation at Tri-County Technical College** in Pendleton, South Carolina, offers short courses on programmable controllers, essential to automated industries, to upgrade the abilities of industry technicians and engineers enough to program equipment and to be able to solve system problems that occur. Courses are both customized to the needs of specific clients such as Michelin and General Electric, at much lower costs than they would incur if conducted internally, and are offered to the general public as well. About 200 people will go through the 25-30 different 22 1/2 hour programs this year.

With all of the new and innovative things technical colleges are doing to promote technology advances and economic development, customized training remains the bread and butter of many schools. Technical colleges still exist in part to serve the training needs of new and expanding businesses, a relic of economic development incentives rooted in the past but still very much alive and at times very successful. Where the occupations require technical skills, however, the technical capacity and capabilities of the program and staff take on added importance.

Skill upgrading, even when company-specific, however, is not quite the same as traditional customized training. Although most skill upgrading is a joint venture with industry, courses are intended to improve the skills of the individual rather than acclimate him or her to a particular firm's style. **Skill upgrading of displaced workers may require beginning with basic skills, which means that technical colleges must have the capacity to provide adult basic education prior to any technical education.**

Digital Equipment Corporation worked with **Southwestern College** in Chula Vista, California, to set up a minicomputer training program. The state eventually matched the value of Digital's donated equipment with a grant of $135,000. The Biomedical Equipment Technology Program at **Stanly Technical College** in Albemarle, North Carolina, operates a program for SunHealth, a leading hospital engineering firm.

The large influx of foreign owned companies in the South also is beginning to affect the education offered in the colleges. **Durham Technical and Community College** in Durham, North Carolina, trains skilled workers for industries in the Research Triangle Park area, including General Electric and Mitsubishi. With a growing number of Japanese companies moving into the area, the school has had to add courses in Japanese history, culture, and management style.

Continuing Education

The **Lintner Center at Portland Community College** in Oregon was dedicated in 1985 to provide advanced education to the state's technical industries It represents a collaborative arrangement with the state's universities and high-tech businesses The center provides a convenient site for continuing education—all the way through graduate programs—to employees of high tech business It acts as broker for educational services that are provided by the state's public and private universities

Technological change and continuing education are inseparable and critically important to a growing economy The best antidote to technical obsolescence is continuing education, and the colleges and universities, which are able to stay abreast of technological changes, are best prepared to be providers Continuing education for other faculty and instructors from other schools as well as for local businesses is a high priority of the technical colleges The Technology Resource Centers in South Carolina ran 164 programs for faculty and staff of the state's technical schools between July 1985 and July 1986

The advantage that technical colleges have over universities, which also have continuing education programs, is that they are within commuting distance of most businesses Many technical colleges, however, attempt to provide the best of both worlds—the expertise of the universities and the proximity of the college—by using technical experts from the universities to conduct courses in person and over telecommunications networks

Some technical colleges are able to provide both on-site courses and conferences and interactive telecommunications The **D. J. Bordini Technical Innovation Center** in Appleton, Wisconsin, conducts professional seminars and conferences that can accommodate 225 persons and has a full multimedia center with satellite teleconferencing capabilities. The school has just begun operating TechNET television, which brings live interactive training to businesses in the state on a regular, 35 hour per week, basis

COMMENTARY

Most new initiatives of technical colleges for promoting technology development are in their early stages The schools are still testing the waters to see what they can do well and how extensive a role they can and should play in local development Their greatest opportunities lie in bridging the chasms that still exist between education and economic development, particularly in rural areas that lack sophisticated technological infrastructure Many of the colleges that have taken initiatives to

spur technology development have become major sources of technology and expertise But they face a number of challenges as well.

Despite rapid growth in enrollments and expansion of activities, funding has been a problem The federal government has not yet discovered the economic value of the technical colleges and federal funds still go predominantly to the high schools in most states. The fact that until 1984 federal legislation had to include a 15% set aside for postsecondary institutions attests to their second-class citizen status. In 1984, new vocational education legislation was enacted that eliminated that set aside and added a set aside for retraining of adults Yet the last time the government released data, postsecondary schools received little more than the targeted amount in many states. Part D of the Carl D Perkins Vocational Education Act of 1984, Industry-Education Partnerships for Training in High-Technology Occupations, which is explicitly intended to support the kinds of technology transfer activities technical colleges are undertaking, has yet to be funded. States and schools that are willing to invest in their technical colleges are finding that compared to other levels of education, the payoffs are quick and measurable

Even though the technical colleges had their start serving students without the wherewithal to attend four-year schools, enrollments of minorities and women remain low in technical programs There are few examples of programs that are targeted to women, such as Women in Technology at Durham Tech in North Carolina.[12] Most special efforts are highly dependent on federal funds, and as federal funding diminishes, the programs tend to disappear The projected decline of high school graduates and increasing proportion of minority students suggest future skill shortages. Technical colleges may soon find that they have to make greater efforts to enroll and educate nontraditional students to meet the demand In addition, two-year colleges have to devote more resources to adult basic education for those displaced workers lacking the basic skills to be retrained for technical work The U S Department of Labor estimates that three-fourths of all displaced workers need basic education prior to retraining

Another challenge that technical colleges may face is ensuring that strong support of economic development does not displace their educational missions The balance between educational and economic development goals, or between meeting the needs of the individual and the economy, is tenuous There will undoubtedly be critics of the new roles of technical colleges if they do not retain a liberal arts curriculum, even in vocational institutions, and an academic environment that supports free inquiry Although economic development is a more prominent goal in the two-year college than in any other educational institution, it must remain subordinate to the intellectual development of the individual

[12] Stuart A Rosenfeld, "Expanding Options for Women in the Southern Work Force," Foresight 2 (July, 1984).

There is little doubt that technical colleges will play a larger role in technology based development in the future and that they will continue to learn from successes as well as failures Based on what is known thus far, the full technology development potential of the technical colleges has not been approached and most programs are still in the embryo stage States ought to re examine the ways their colleges are organized, governed, and funded to see if they have the flexibility and resources they need to effectively serve their students, communities, states, and regions

RECOMMENDATIONS

- Each two-year college ought to meet with local or area economic development agencies, chamber of commerce, and civic and labor organizations to **reassess its mission** and establish the extent to which it wants to be involved in economic development

- Each two-year college that wants to play a larger role in economic development ought to **prepare a long-range plan** for how it can best achieve its goals, including what resources it will require, how it will balance its liberal arts programs with its occupational programs, and how it will respond to the needs of those segments of the population that have not fully benefited from technical programs in the past.

- States ought to recognize the unique features, needs, and contributions of two year colleges and **develop appropriate legislation** that combines educational and economic development goals.

- Each state should **examine its budgets** to see if allocations to two year colleges have kept pace with increases in enrollments and with expanded responsibilities

- State agencies responsible for two year colleges ought to be included along with the boards of higher education in all **technology development programs**.

- States ought to **evaluate 2 + 2 + 2 programs**, looking at how the last two years of high school, two-year programs, and bachelor degree programs can be linked to provide both employment and further educational opportunities for youth.

- With increasing basic skills needs, two year colleges ought to **coordinate adult basic education** as well as technical education Though not necessarily the most effective delivery system for adult education, the college system could coordinate, administer, and fund state-wide programs to seek out adults who lack skills for technical work

- Selected two year colleges should **establish demonstration laboratories for businesses to become acquainted with and experiment with the latest manufacturing technologies**, much as the vocational technical colleges of West Germany do The two year colleges could do for industry what demonstration farms once did for farming

RESOURCES

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PREPARING TECHNICIANS FOR A COMPETITIVE WORKFORCE

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This paper focuses on the role of the advanced level technicians as a key factor to higher productivity and quality. Hull implies that most of our public institutions are inadequately prepared to educate/train and retrain these new technicians. He describes a model training strategy and encourages two-year colleges to cooperate with high schools in a "two-plus-two" articulated curriculum Hull tells us of the "Retraining for Technology" model being implemented in Tennessee. Most of all, Hull reemphasizes what Choate and Linger point out and Rosenfeld confirms. the competitiveness of America depends on the availability of a well trained work force who depend on an effective, multifaceted, educational system.

Executive Summary "Preparing Technicians For a Competitive Work Force" by Daniel M. Hull

The competitiveness of America depends on the availability of a well-trained work force who depend on an effective, multifaceted, educational system. To understand what the role of secondary and postsecondary schools should be in their support of industry, we must (1) identify the abilities needed in technical workers, (2) examine how technicians are prepared and updated by formal or informal training; and (3) make recommendations that ensure the optimum use of our educational system.

U. S. workers are not being properly prepared for the competitive challenges of a world economy. Educational forces must help industry develop and maintain a competitive edge. We must restructure our work force to be (1) diversified, (2) focused on quality, (3) problem-solvers, (4) productive; (5) responsive to change; and (6) retrainable.

Currently, a production team is composed of (1) assemblers who are being replaced by robots or workers from developing countries, (2) craftspersons who are being replaced by computer-controlled machines, (3) operators whose need is increasing, and (4) technicians who will fill the void between engineers and other production workers and machines.

The role of public education in preparing these groups should be reexamined Public education and training institutions should deemphasize or eliminate training for assemblers or operators. Craft training should be evaluated frequently to determine the supply-and-demand ratio. If a need is valid, students should be taught basic scientific principles, as well as tools and procedures.

It is the training role for the new technician that requires the most scrutiny. We know technicians are needed to build, modify, install, maintain, repair, and calibrate today's new, complex equipment in fields such as, (1) manufacturing plants, (2) processing plants, (3) hospitals/clinics, (4) communication systems, (5) power-generating plants, (6) modern buildings, and (7) automobiles/ transportation. We have identified nine tasks that we know technicians must be trained to perform. We also know that most of our public institutions are inadequately prepared to educate and train the numbers or the quality of technicians needs.

Recommendations to solve these problems include. (1) technical education and training should be focused at the two-year postsecondary level, (2) technician education/training curricula should be restructured with statewide models developed, tested, and required, (3) high school students should be counselled and persuaded to begin preparation for technician education/training in the eleventh grade through 2+2 articulated curricula, (4) postsecondary institutions should test students and place those who need it in remedial "tech-prep" curricula, (5) training programs designed to train displaced workers should use adapted versions of the "Retraining for Technology" model, (6) short-term retraining/upgrading courses should be offered by technical institutions, and (6) a cooperative, statewide, computerized network for sharing curriculum and teacher resources should be established.

PREPARING TECHNICIANS FOR A COMPETITIVE WORKFORCE

Introduction

The Production Team
- Assemblers
- Craftspersons
- Operators
- Technicians

The Role of Public Education in Training the ProductionTeam
- Training Assemblers and Operators
- Training Craftspersons
- Training Technicians

Technician Training Programs
- Characteristics Employers Want in Technicians
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The Core Curriculum. An Efficient and Cost-Effective Approach

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- High School Students and Adults Seeking Career Changes
- Retraining Displaced Workers for Technology

The Need for Cooperative Networks

Recommendations

PREPARING TECHNICIANS FOR A COMPETITIVE WORKFORCE

Daniel M Hull, President
The Center for Occupational Research and Development

INTRODUCTION

Economic health in a world market requires that business and industry develop and maintain a competitive edge Succinctly stated, this means that desirable products and services must be developed and delivered at attractive prices. Thanks to the ingenuity of scientists, engineers, and other specialists, the U.S generates an abundance of ideas for and about new products, we lead the world in the number of new inventions each year. The people who think up and design new products, however, are not the ones who make them in mass quantities. This task falls to another group of people: the production team.

If members of the production team do their jobs well, sound management and marketing practices may parlay the products into national and international successes. If the production team does its job poorly, they probably turn out products that are overpriced or that under-perform—or maybe both Consumers, who are becoming increasingly discriminating, are likely to reject what they are offered, and competitiveness becomes a goal still to be achieved rather than a milestone of success.

Since the nation's production teams play a critical role in determining the degree to which competitiveness is realized, they are an important consideration in national planning for economic development. Their training and education, therefore, are national concerns.

Who are these people who make up production teams? What do they do? How are they trained? How can their performance be improved? Above all, what training and education issues does this group raise, and how are these issues addressed? These are the questions that this paper explores, with a particular emphasis upon one group of the production team. the technicians. They, among all workers, are most able to leverage the talent and knowledge of scientists, engineers, designers, and business strategists for they combine a knowledge of technical principles with hands-on skills How we manage our educational resources to meet their training needs is a matter of utmost importance.

THE PRODUCTION TEAM

Products are produced by a team made up of four groups. assemblers, craftspersons, operators, and technicians

Assemblers are unskilled or semiskilled workers who are usually engaged in routine tasks that require little training In many cases, assembly work now is done by robots Where manual labor still is required, employers look to workers from developing countries, at much lower wages. Examples of such employers include manufacturers of shoes, clothing, furniture and electronic equipment Assemblers are very susceptible to becoming displaced workers.

Craftspersons are highly skilled workers, trained in the use of tools and techniques for specific processes and operations Craftspersons include machinists, drafters, welders, electricians and carpenters When an industry changes tools or techniques, its craftspersons may become obsolete and require retraining The need for craftspersons is declining in areas where computer controlled machines and processes are becoming more widely used

Operators provide the man-machine interface for tasks like word processing, laser cutting, electric power generation, truck driving, and robotics Operators interpret manuals and specifications to make a machine work properly. Generally speaking, they work with devices such as buttons, knobs, and displays on the "outside" of the equipment. When necessary, they make "external adjustments " In some fields, the need for operators is increasing

Technicians, the fourth group on the production team, are the most critically important members In the broadest sense of the word, a technician may be thought of as a paraprofessional who is educated and trained to extend the thoughts and hands of a professional in any one of a variety of fields such as medicine, law, accounting, and engineering The focus here, however, is on engineering technicians—those technicians who build, modify, install, maintain, repair and calibrate today's complex new equipment that is found in places as diverse as manufacturing plants, intelligent buildings, communication systems, hospitals, and power-generating plants Some technicians are production workers and some are service workers.

In contrast to the operator, who works on the "outside" of equipment, the technician works on the "inside" of the equipment, where gears, computer chips, motors, fiber optics, hydraulic actuators, lasers, ultrasonic sensors and vision systems are found To build, install, operate, and keep equipment working efficiently, technicians must know about all the different devices of a machine and how they work together. The types of tasks that technicians perform are shown in Table 1

To be competitive in the world economy, production teams are needed that may be characterized as—

* Diversified
* Focused on quality
* Oriented toward problem-solving
* Productive
* Responsive to change
* Retrainable

Table 1. Tasks Performed by Engineering Technicians

- Perform tests of mechanical, optical, hydraulic, pneumatic, electrical, thermal and electronic/digital components or systems, prepare appropriate technical reports covering the tests.
- Obtain, select, compile and use technical information from computer-controlled measuring, recording and display instruments
- Use computers to analyze and interpret information
- Prepare or interpret engineering drawings and sketches Write reports, working procedures and detailed specifications of equipment
- Design, help develop, or modify products, techniques, and applications in laboratory and industrial settings
- Plan, supervise or assist in the installation and inspection of complex technical apparatus, computer equipment, and control systems
- Operate, maintain and repair apparatus and equipment with computer-controlled systems
- Advise, plan and estimate costs as field representatives of manufacturers or distributors of technical apparatus, equipment, services and/or products
- Apply knowledge of science and mathematics to data analyses while providing direct technical assistance to scientists or engineers engaged in research, experimentation and design.

All members of the production team must be trained to focus on quality and to be productive It falls more to technicians than to other groups, however, to be diversified, oriented toward problem solving, and responsive to change Also, technicians are more retrainable than other groups on the production team.

THE ROLE OF PUBLIC EDUCATION IN TRAINING THE PRODUCTION TEAM

Each group within the production team requires training. The support of public education in providing this training, however, should not be equal for all groups

Training Assemblers and Operators

The role of public educational institutions in preemployment training of assemblers and most operators should be limited or nonexistent Since 1981, hundreds of public institutions developed programs for training robot operators This is an example of a costly mistake Since the training period is relatively short and the training content is specific to a company's equipment/process, the

training provided by the employer is effective and adequate Many of the jobs for assemblers and operators will likely be filled by dislocated workers.

Training Craftspersons

Craft training for youth and adults has been and probably will continue to be conducted in secondary and postsecondary vocational programs But craft training programs are changing, and increasingly they are coming under scrutiny There's a growing recognition that students should learn **why**, as well as **how**, something works, that they should know the principles as well as the tools and procedures of their jobs So equipped, they become potential problem-solvers and, therefore, more valuable workers In addition, they are more easily retrained when the job requires it.

Craft training programs also should be evaluated continually against the criterion of "supply-versus-demand" to determine whether a program should continue and how large the enrollment should be In the past five years, for instance, dozens of schools have created or upgraded welding labs (typically costing approximately $300,000), while reports indicate that in the next few years thousands of journeyman welders will lose their jobs, the result of implementing automated welding processes

Training Technicians

Technicians require more than a high school education, but less than that provided by four-year postsecondary institutions They must be trained in a well-designed curriculum that is comprehensive and, probably, demanding. In the past, many technicians have entered industry after having been trained in the military. In the future, however, most of our technicians for advanced-technology industries will come from two sources.

1. Postsecondary programs in community colleges and technical institutes

2 Special Retraining programs designed for workers from industrial jobs that have become—or soon will become—obsolete.

Students who enter public postsecondary technical programs typically fall into two groups students eighteen to nineteen years old who enter immediately after high school graduation and older adults who return to school because they are attempting to make a significant career change. The public education programs that most successfully meet the needs of its students offer remedial courses to those who are not sufficiently prepared either technically or academically

In cooperation with two-year postsecondary institutions, public high schools also serve a role in training technicians through two plus two articulation programs Simply stated, two-plus-two articulation is an agreement between a high school and a postsecondary institution that enables a student to begin an associate degree or its equivalent while still in high school, beginning with the

eleventh grade Under prescribed conditions, credit for certain high school courses is given by the postsecondary, degree-granting institution.

TECHNICIAN TRAINING PROGRAMS

If today's technicians are to support the national competitive edge by being diversified, problem solving workers who focus on quality and productivity and who remain retrainable and responsive to change, they are being asked to assume roles with new significance and responsibilities in business and industry. Consequently, the curricula that train them need to be reconsidered and, in many cases, redesigned.

Characteristics Employers Want in Technicians

The reports of hundreds of employers have confirmed that they want technicians who—

- understand how systems and subsystems are interrelated.
- possess a combination of knowledge/skills in mechanical, electrical, fluid, thermal, optical and microprocessing devices.
- have a strong base in applied math and science and are capable of learning new specialties as the technology changes.
- are adept in the use of computers for data acquisition, storage, manipulation and display, for automated control of machines; for use in design.
- have the ability to read, write, listen, speak and work with other people—in technical teams, with others in the organization, and with customers.

Curriculum Changes Needed

The characteristics that employers require in their technicians call for three fundamental changes in technical curricula

1 Increase the interdisciplinary content of curriculum materials If we examine what's inside most modern technological equipment, we find combinations of devices—electronic circuits, gears, belts, mechanical linkages, motors, hydraulic systems, pneumatic devices, optical sensors, heating/cooling equipment and a computer. If a computer or some other electronic circuit malfunctions because it is not cooled properly or a motor "burns out" because a gear system is misaligned or "frozen," who is supposed to fix these problems? The electrical

technician? The mechanical technician? The computer technician? Today, the services of all three would probably be required

Equipment has diversified but technical education and training programs still produce narrow specialists Industry hires them because that's all that is available New technician curricula should provide a broad base in electrical, electronic, mechanical, fluidic, thermal, optical and computer technologies As student-technicians learn the interrelationships between these fields, they acquire an orientation toward "systems"

2 Teach the principles Today's technicians are the bridge between theory and hardware They know equipment, tools and instrumentation, and they can work well with their hands. But they also must be able to work intelligently—with their minds. To solve problems in today's complex world of technology, merely knowing **how** something works is not enough, knowing **why** is equally important Knowing **why** means understanding the operating principles of the technology as demonstrated in real applications.

Teaching principles calls for a substantial curriculum emphasis in applied math and science. Applied academic courses should not be "watered down" academics. Rather, "applied" means that they are taught with relevant examples and applications labs wherever possible.

Departments of vocational education in forty-six states have already begun addressing the need for applied academic courses Joining together, these state departments sponsored the development of a high school course in applied physics called **Principles of Technology** This course has been developed, tested, and revised By the fall of 1987, it will have been implemented in 500 to 1000 schools. Developed at a cost of approximately $3 4 million, this cooperative project has proven that many low-achieving high school students in the general track can perform very well in an academically rigorous course like physics if the principles are taught through relevant, hands-on applications Development of similar courses in Applied Math and Applied Communication are underway

3 Develop interpersonal skills Recently, a series of on-site interviews were conducted with twelve major technical companies in a large midwest metropolitan area In the course of each two-hour interview, the employer was asked, "If you could, what single characteristic would you change in the technicians you currently employ?" All twelve employers strongly emphasized that their technicians ought to have better interpersonal skills, and that these skills are needed both inside the plant and outside the plant.

Inside the plant, the employers said, technicians need to be team players who can cooperate to achieve common goals They also need to be able to communicate effectively through speaking, writing and by using graphics. Externally, service technicians are the representatives of the company to customers—many of whom may not have an appreciation for the technical problems with which they deal They just want things fixed—in a timely and pleasant manner

In addition to being experts, then, technicians are required, with increasing frequency, to serve as public relations representatives

THE CORE CURRICULUM: AN EFFICIENT AND COST-EFFECTIVE APPROACH

Fortunately in this decade, educational institutions have begun to recognize the need for technical education that is broad-based and focused on teaching principles. The movement, however, is slow and inconsistent and, in most cases, it lacks state leadership. The process would benefit greatly from clearly identified statewide curricula in the various technologies—and curriculum development should be guided by the concept of the common core.

A careful examination of the curricula needed for eight to ten different technical fields reveals that over two-thirds of the courses are common to all fields. This suggests that a "common core" curriculum could be implemented to serve the education and training requirements of nearly all the technologies A curriculum designed to produce broad-based systems technicians should be made up of two main parts a common core and a specialty sequence. This curriculum structure is shown in Figure 1

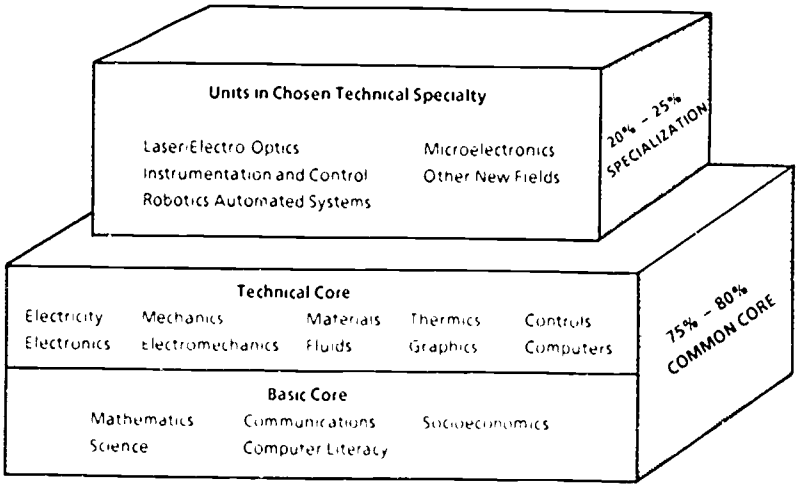

Figure 1 Core curriculum structure

The common core has two components. a basic core and a technical core The basic core consists of courses such as algebra, physical sciences and socioeconomics The technical core provides broad-based skills in areas such as electronic devices, fluid power and the properties of materials. This depth of study prepares the technician for concentrated coursework in a specialty area

The second part of the curriculum, the specialty sequence, ensures that the student attains a level of expertise in a chosen high tech specialization The specialty sequence usually consists of five

or six courses Curriculum paths to become a technician in specific areas of specialization are shown in Figure 2

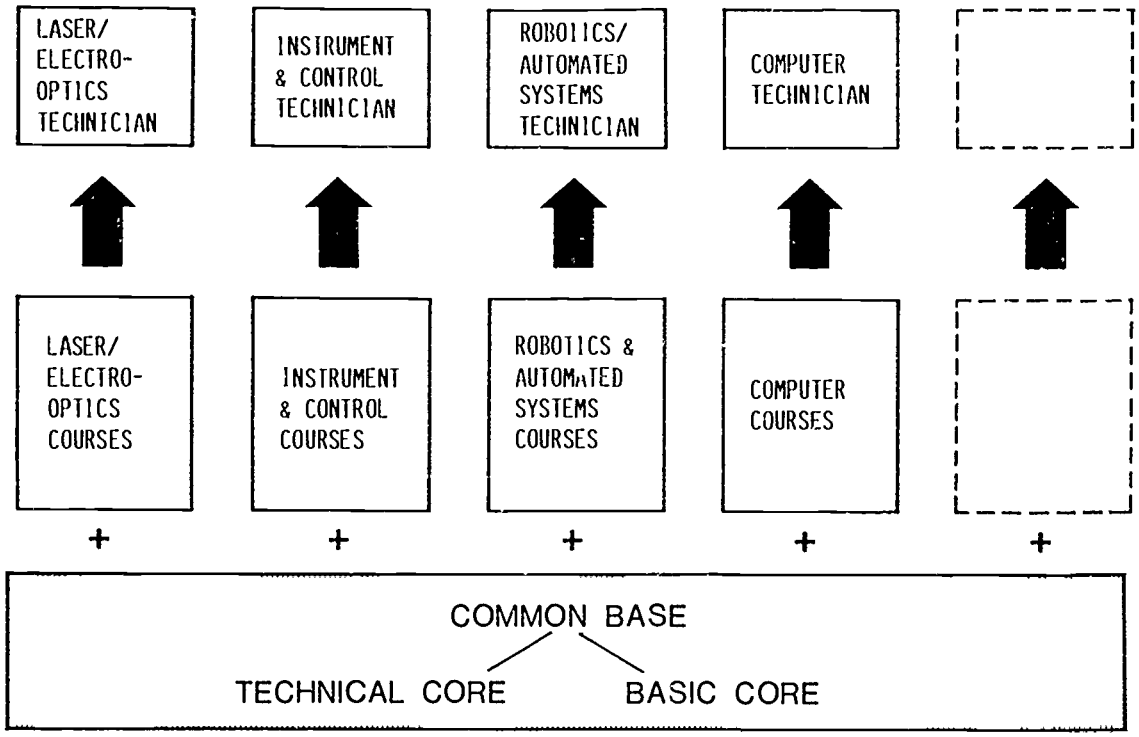

Figure 2 Advanced-technology curricula

The combination of the common core curriculum and specialty courses ensures that a technician will have the broad knowledge base and flexibility needed to function efficiently in advanced-technology occupations As can be seen in Figure 3, the common core makes up the greatest part (more than 75%) of the technician's training

A partial listing of the high tech fields of specialization that can be supported by the common core curriculum includes. computers, telecommunications, computer-aided design, robotics/automated manufacturing, instrumentation and control, laser/electro-optics, intelligent building management, biomedical instrumentation, and biotechnology

The majority of the technical core is founded on a basic core course called Applied Physics—A Systems Approach It provides a broad knowledge base and directly supports high tech occupational competency in four types of systems—mechanical, electrical, thermal and fluidic The emphasis in this course and other courses in the core curriculum is on practical applications, real-world examples, and helpful, unifying analogies of physics principles that enable a technician to treat problems in all these systems with the same relative ease and competence

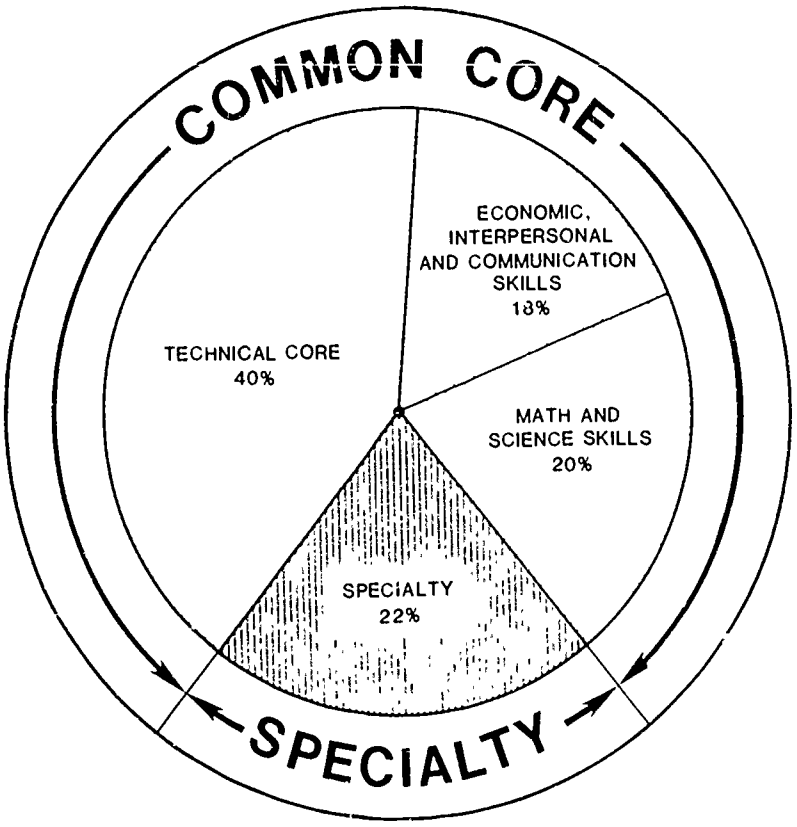

Figure 3. Proportional view of core curriculum.

In traditional schools where several related engineering technology programs exist at the same time and the **core curriculum** is not offered, courses equivalent to the technical core courses are offered separately to each of the several types of technicians. This is not efficient In schools where the core curriculum is offered, these same courses may be combined into common basic core and technical core classes for all technologies. This consolidation reduces the number of such classes, makes better use of teaching staff, and is more cost effective in terms of classroom and laboratory facilities In other words, schools can provide a better product at a lower cost.

Curricula based on the common core concept provide students with a broad-based, systems-oriented education that opens up job opportunities not available to narrowly specialized technicians This broad based preparation also opens doors to lateral transfer or promotion in industry and, effectively, insures against job obsolescence and future unemployment

HOW STUDENTS ENTER TECHNICIAN TRAINING PROGRAMS

Persons seeking entry into technician training programs may be high school students, students just out of high school, older adults who want to make a career change, or adults who need to be

retrained because of job obsolescence Figure 4 shows how these various types of students enter technician training programs

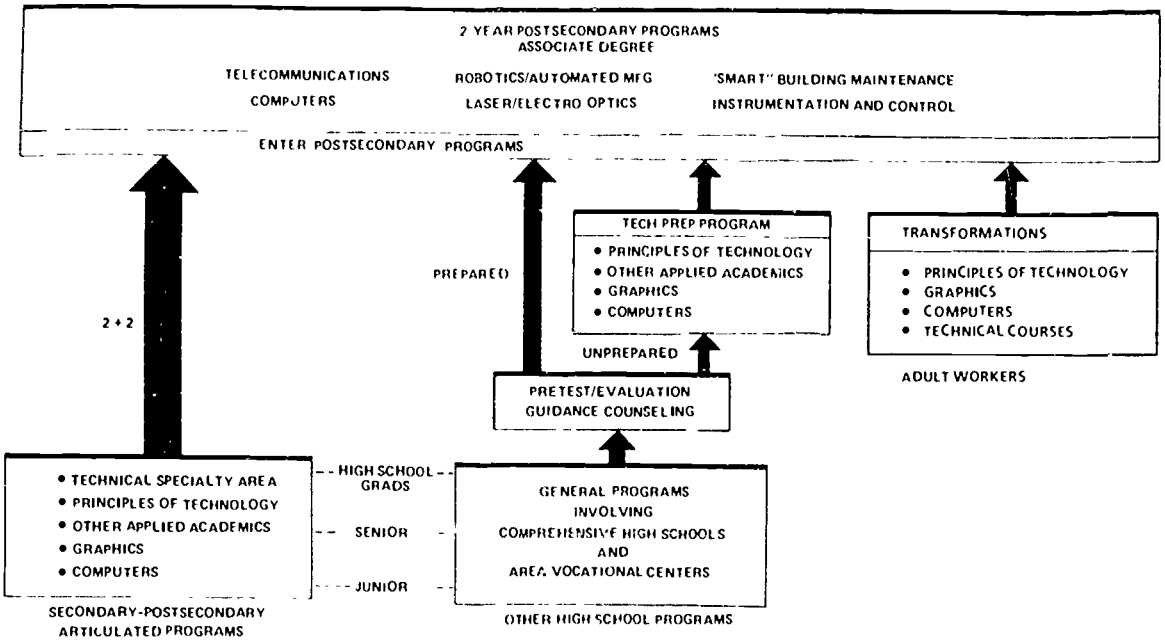

Figure 4. How students enter advanced-technology programs

High School Students and Adults Seeking Career Changes

The path on the left side in Figure 4 is for high school students in the two-plus-two articulation programs This process can provide students with more direction, better preparation for entry into postsecondary colleges and time for co op or work experience The high school portion of the 2 + 2 curriculum begins with a series of applied academic courses in math, science and communications. It also includes courses in computer literacy and technical graphics, and an introduction to the technology of interest

Persons who are not high school students participating in a two plus-two articulation program may need testing, evaluation and "tech prep" training, as shown in the center section of Figure 4 These students may have just graduated from high school, or they may be older adults wanting to make a career change In either case, they probably did not prepare adequately for entry into technician training and will have to take some portion—or all—of the tech-prep remedial program The content of the "tech prep" program is essentially the same as the high school portion of two-plus-two articulation

Retraining Displaced Workers for Technology

As our industries continue the metamorphosis that began early in this decade, more and more semiskilled workers will find themselves in jobs that have or soon will become obsolete. Specific examples of this situation are evident in the automotive, steel and communications industries. These displaced adult workers will have to prepare for new careers. If they want to remain with their present employer or with a related industry, some will seek to be retrained as technicians. Many of these will have poor math and verbal skills and will have had little or no practice in using these skills for the past ten to thirty years.

This past year, a "Retraining for Technology" program was tested in Southeast Tennessee with a group of displaced workers in a copper mining processing operation. This program, called Transformations at Copperhill, presents a new approach for retraining displaced workers for careers in modern technology. It begins with testing and remediation in math and verbal skills, followed by 400 hours of technical training. The curriculum is built on the foundation of the Principles of Technology physics program described earlier. It is supported by courses in technical graphics, computer use, electronics, fluid power and mechanical devices. Since last October, the first group of workers have received this training by attending classes and labs after work, three hours a day, four days a week. They are doing well. They plan to complete the program and take jobs as technician trainees in the surrounding area. Currently they are being interviewed by employers in north Atlanta, representing fields of manufacturing, telecommunications, process control and industrial maintenance.

After they are employed, these retrained workers will be able to continue their education in technology at nearby postsecondary institutions. This path for retraining displaced adult workers is shown on the right side of Figure 4.

What is emerging is a holistic approach to training technicians for advanced technology careers involving:

High school students
Adults involved in career change
Displaced workers

THE NEED FOR COOPERATIVE NETWORKS

The plan summarized in Figure 4 offers a long range solution to the need for the new type of technicians, but it will not "pay off" until considerable resources are invested and several years have passed. In the interim, we must find efficient short term ways to retrain and update our technical workers in the use of the latest equipment, materials, and processes

Vocational, technical and community colleges provide update training and retraining, but they are faced with serious limitations in terms of faculty, up to date equipment, and curriculum development In isolated cases, high-quality retraining courses have been developed and administered in areas such as programmable controllers, statistical process control, laser welding and fiber optics As long as schools work in isolation of each other, however, updating and retraining will suffer from limited resources and duplication of efforts

What is needed, statewide and nationally, is a network of schools that develop new courses and skills and then share with each other Consider this example Suppose School A in one part of the state has developed a course in statistical process control and has a qualified teacher School B in another part of the state has a request from a local industry for a similar course With a cooperative network, School B can access a data base, find that School A has developed the course, and effectively "broker" the course to the industry in School B's service area The course can be taught by School A at School B's facility, taught at School A, or taught by School B using the curriculum developed by School A

RECOMMENDATIONS

The most important group in production teams, the technicians, are in short supply today In addition, many of those that do exist are inadequately prepared to deal successfully with the forces of change so that they can remain in modern technical employment As a result, they cannot participate as effectively as they could or should in the delivery of high-quality, cost efficient products, processes, and services in the modern technological world. They cannot, in effect, contribute effectively to the economic development of our nation

The following recommendations are offered to help solve this problem

1 Program offerings for craft workers, assemblers and operators should be evaluated frequently to determine whether the supply is outrunning the demand Where the need is valid, students should learn principles as well as tools and procedures

2 Technical education and training should be focused on completers at the two year postsecondary level

3 Technician education/training curricula should be restructured along the following lines
   a Core curriculum concept for a cluster of technologies
   b Strong base in applied math, science and communication/interpersonal skills
   c Systems-oriented courses and programs
   d Emphasis on interdisciplinary skills and principles

   Statewide models of core curricula should be developed and tested

4 High school students should be counseled and persuaded to begin preparation for technician education/training in the eleventh grade or earlier through two plus two articulation programs

5 Postsecondary technical programs should not be "watered down" to accommodate unprepared students Instead, postsecondary institutions should test incoming students and place those who need it in remedial "tech-prep" curricula

6 Long-term industrial training programs—designed to upgrade the technical abilities of current and displaced workers—should concentrate on building a strong technical foundation instead of concentrating on narrow training about specific equipment or procedures that are likely to become obsolete within a few months or years

7 Specific retraining/upgrading courses for industry should be offered by public technical institutions through a cooperative statewide network to broker other institutions' courses and eliminate duplication of curriculum development and other institutional resources

National Roundtable on Economic Development
Preface

Leaders from business, education, and government met in Nashville, Tennessee on July 17, 1987 to discuss the evolving role of community, technical, and junior colleges in helping meet the nation's future human resource needs. To stimulate the initial conversation, three policy papers were prepared by Pat Choate, J.K. Linger, Stuart A. Rosenfeld, and Daniel M. Hull.

The diversity of regional, state, and local economic requirements challenged consensus formation, but Roundtable participants did leave the meeting after a long and spirited discussion with an overwhelming agreement in three areas.

First, participants agreed that community, technical, and junior colleges should prepare to play a significant role in the process of creating a more competitive and productive work force. In order to do that, the colleges will have to organize in a variety of ways that best reflect the needs of their local economic community.

As Roundtable co-chair, former North Carolina governor and state community college president Robert Scott said, "Community colleges are uniquely positioned to play a major role in economic development. They're positioned geographically. They offer low tuition. They have an open door philosophy, and community, technical, and junior colleges are positioned to respond quickly."

Dovetailing his remarks with those of Scott, former Mississippi Governor William Winter reminded fellow participants of the economic stakes involved in their discussion. "We can make substantial investments in physical structure . . . we can build four-lane highways and we can create water and sewer systems, but unless we have an investment in human beings that will enable them to compete for higher skill jobs, we will not be competitive at the community level, the state level, the regional level, or at the national level . . . and it is my judgment that the nation's community, technical, and junior colleges represent a key player in helping the American economic community transform the work force to meet present and future challenges. This is a new role for most of the colleges, but it is a more important and vital role than their traditional role."

That position was solidly supported by William F. Willis, General Manager of the Tennessee Valley Authority who stated, "The colleges are in that role. They don't have a choice. They are involved in education and training that impacts economic development and they are going to find that involvement increasing. . . . When a local company says we can't match our new technologies with talented workers, the local college has got to be part of the solution to that problem."

Esther Schaeffer, Vice President of the National Alliance of Business, cautioned that the challenge of human resource renewal was so great and so complex that the colleges should seek broad linkages across all lines to enhance their effectiveness. Schaeffer believes that community, technical, and junior colleges increasingly will find themselves in the role of "convener" and "broker," serving as key institutions in marshalling the assets of the community in the service of human resource renewal.

Secondly, Roundtable participants agreed that the community, technical, and junior colleges could fill a substantial portion of the ongoing education and training needs of a large segment of the U.S. labor population. However, it continues to be imperative that the colleges accurately assess and respond to their local employer community needs. This represents no small challenge as technology drives and complicates business leader decisionmaking to the point that long range projections are difficult to obtain.

Roundtable participants determined that, when making decisions about how to organize their assets as they set about delivering instruction that prepares a competitive and productive work force, it is important that community, technical, and junior college educators continue to respond to the changing needs of students who walk through the open door. They emphasized that care must be taken to see that the "open door" does not become a "revolving" door by becoming academically selective or by becoming prohibitively expensive. Moreover, Roberts T. Jones, Assistant Secretary at the Department of Labor, pointed out, "Thirty percent of the new workers are going to be Black, Hispanic, or women. The average age of workers will be older — 35-39. . . . These folks will reflect major challenges in terms of motivation and minimum competency skills. Other people are going to be moving out of jobs, so some of your clientele is going to be a group of people who aren't particularly excited about being retrained when, in fact, they've been strong union members in high-paying jobs for a number of years." These adults represent a new challenge in terms of training relevancy and curriculum development.

Roundtable participants indicated that community, technical, and junior colleges are a logical delivery system for technology transfer activities, for technical training, for literacy training, for customized training — for whatever training industry needs its work force to have.

Third, Roundtable participants agreed that the "nontraditional" student became the traditional student at community, technical, and junior colleges a long time ago.

"That's something we've already dealt with — and we've been dealing with it to a greater degree than most institutions," said Edward "Sandy" Sanders, Whirlpool's manager of government relations and training in Arkansas.

However, as Flora Edwards, president of Middlesex County College, pointed out, "We are faced now with two conflicting sets of propositions. We've expanded access, and we've upped requirements. We're looking at students as college material whom we never thought were going to be college material."

It was just this conflict that prompted many of the participants to rally behind the concerns of Philo Holland, vice president, Sears-Roebuck and Co. "We need balance between our basic educational mission and possibly economic development . . . I would hope that we do not conclude that as a primary mission economic development should be required of community colleges throughout the country," he said, "because, in fact, job preparation, in my opinion, is a far more important role . . . If we don't have youth, young adults and adults basically trained with a solid foundation of education skills, we don't have much of a chance to go further in high tech kinds of skills."

James R. Adams, president of Southwestern Bell Telephone Company, concurred with Holland in saying, "I'm a business person, so I keep looking for focus when we are talking about economic development. . . The objective ought to be primarily job placement and job training. That doesn't rule out some of the more creative economic development collaborations between the colleges and the economic community. It just means that sort of activity ought to be kept in proper perspective."

Can community, technical, and junior colleges accomplish the goals of economic development that will ensure U.S. global competitiveness? The concensus of Roundtable participants was "Yes, but it will be a difficult job." As Sandy Sanders said, "Whether or not it's articulated as a goal or an established policy, economic development is part of the community college activity, and part of the community college movement."

As for what community, technical, and junior colleges are doing to prove their sincerity, Nolen Ellison, president of Cuyahoga Community College, pointed out, "Community colleges are 'bullish' on economic development. With or without federal legislation, college presidents are out there in the trenches working with businesses."

Roundtable participants were quick to reinforce, however, that it isn't just the community, technical, and junior colleges who must gear up to help our nation become more competitive and productive. Roundtable participants recommended a "multi institutional" approach, setting as priorities collaboration, partnership, and networking between education, business, and government.

"Somewhere along the line, I hope we say this," said Michigan State University President John A. DiBiaggio. "It [gearing up for economic development] isn't solely a community college's function, or a university's function, or a four-year college's function, or a secondary school's function. Quite frankly, we're all in it together, and if we don't all pull together, then the nation is going to be in difficulty. And directly or indirectly, all our institutions are going to be in difficulty."

by James F. McKenney
Associate Director
Keep America Working Project
AACJC

W. Carroll Marsalis
Program Manager
High Technology Demonstrations
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ROUNDTABLE OVERVIEW

EDUCATION AND ECONOMIC DEVELOPMENT: MORE THAN A RHETORIC GAME

by Cassy B Jordan
Center for Occupational Research
and Development

"Demographics is a fascinating game to all of us," said former North Carolina Governor Robert W Scott as the Roundtable on Education and Economic Development began to wind down for the day Twenty-one education, business, and political leaders engaged in a hard and fast exchange of demographics and the role of the community, technical, and junior colleges on economic development on July 17, 1987 in Nashville, Tennessee And although demographics are not always as clear as crystal, demographics are about the only sound way that educators, politicians, and business people have to predict future trends. So it was a day of demographics and prophesies, sponsored by The Sears-Roebuck Foundation and the Tennessee Valley Authority. It was also a day of brainteasing — and brain-testing — discussion followed by recommendations. Participants used papers written by four of education's trendsetters as catalysts to their discussion.

Little talk was devoted to dollars Some people might find that curious among a group of educators, politicians, and business people who discussed economic development Perhaps the U S Assistant Secretary of Labor explained why best. Roberts T Jones said that in the next few years, "There's likely to be an embarrassment of riches in the amount of training dollars that are available" Jones, who oversees the administration of all Employment and Training Administration programs (including the Job Training Partnership Act), continued, "Not only do we see training becoming one of the top priorities of collective bargaining now, but we have this discussion of ITAs and the tax incentives for corporate investment in training" "ITA" refers to a proposal to initiate individual training accounts, similar to "IRAs," individual retirement accounts

"Congress will pass a billion dollar training program for retraining workers this year in the midst of the worst budget crisis ever I think the list would be substantially longer if vocational education could ever straighten up its political act," Jones said, adding that he believes the amount of voted money will increase In fact, Jones predicted that "there will be more money per American worker between private and public resources in the next 20 years than we've ever seen before," and that community, technical, and junior colleges are going to find themselves "not wondering who pays for it but more involved in the issue of roles and functions and productivity The dollars must be there, because we can all lose in this national struggle for global competitiveness — educators, business persons, and government officials alike There's something at stake for us all," Jones concluded

The focus of the Roundtable talk was on what roles and functions community, technical, and junior colleges should play in economic development activities – and how they can make themselves most responsive, efficient, and productive in the progress. Time and again, the talk turned to demographics and predictions. For example, many quoted statistical soothsayers who predict that the new entrants into community, technical, and junior colleges are going to be Black, Hispanic, and/or female, that the average age of the work force will be 35-39 (older than they are now), and that there will be a sharp increase in immigrants.

"Many of the people who will need training will be angry, particularly," Jones said emphatically, "if they're being trained to be widget makers when they've been strong union members in high-paying jobs for a number of years." Jones proved himself a plain talker more than once. "Sure, it's great to have a beautiful campus, a community college, a technical program, and say 'come on over here — have we got a deal for you.' But it's a fraud in terms of that worker's security and the ability to survive in that labor market — particularly if the substantial portion of them (students) are minorities and women and immigrants and people who have not traditionally participated in the programs and have a weaker basic set of skills.

"I think we're going to have to change the process. A portion of our society has never been looked upon as a significant contributor to the labor force in this country. It's been a social issue, but not a political or economic issue. Now it's an economic issue. Black and Hispanic populations are to a sufficient degree not participating. They're not in your community colleges. They're not benefiting from the process. In the next ten years, either your systems won't be full or these people will be in there," said Jones.

Esther Schaeffer, vice president of the National Alliance of Business, reinforced Jones. "We're talking about students who haven't come close to getting into a community college door, who never made it to high school or made it through high school and are, therefore, undereducated. Yet these are the people that employers will be needing, because the pool is drying up in terms of entry-level workers," she said.

Much of the day was spent determining how community, technical, and junior college programs could meet the needs of this entering group of students at the same time they are meeting needs of a more highly skilled worker. What might be the right activity for one institution or one kind of student might be the wrong activity for another. The concensus became a realization that meeting economic development goals would require highly sophisticated and diverse implementation strategies.

Scheaffer remarked that the solution lies in having community, technical and junior colleges continue to meet a series of needs through a variety of activities. Those activities include 2+2 and 2+2+2. They include customized training. They include some of the more elaborate or extended customized training – or whatever one might want to call the more generic training. "I'd like for it not to include remediation, but it will for awhile because so many of the students aren't going to have it as they come up from K-12," Schaeffer said.

During the discussion, the problem of preparing a work force to ensure economic competitiveness and productivity, i.e., national prosperity, became clear. "The problem," as Schaeffer described it, "is much bigger than any one institution, much bigger than all the public institutions combined, much bigger than the private sector can handle. In different communities, there are different institutions, both public and private. These institutions have to get together and sort out roles and responsibilities," Schaeffer said.

What are those roles and responsibilities? Scott set the stage for those answers at the discussion's outset when he said, "There's a research triangle that's even more important than the one in North Carolina. It's the significant triangle of interaction that's evolving across the country between government, business, and education."

Community, technical, and junior colleges will play a significant role in that triangle. "An avalanche of responsibility for educating the U.S. population is going to be placed on community colleges," warned Washington, D.C. Federal Laboratory Consortium representative Lee Rivers.

Part of that avalanche will be meeting the growing need to retrain adult workers. As Middlesex County College president Flora Edwards said, "Without the proper support by educational institutions, we'll have an awful lot of people competing for jobs that don't exist, and not enough people qualified for the jobs that do exist. The terminal degree is a myth in a climate that requires lifelong learning. By the year 2000, an illiterate will not be one who can't read. An illiterate will be one who can't learn, unlearn, and learn again."

The ability to train and retrain the necessary work force is the key to enticing businesses into a community. Former Governor William Winter of Mississippi shared an anecdote that illustrates this point. "As governor of Mississippi, I've been frustrated by having seen a time lag that was catching up with us. I recall with great disappointment the experience I had just weeks after I was inaugurated.

"The director of our department of Economic Development called me at the mansion and said, 'I've got some good news. You're going to be able to announce the location of a major electronics plant — a high-skilled, high-wage company that's coming to Mississippi.' I could savor the experience of standing up in front of all those TV cameras and talking about this plant that I could take no credit for having gotten, but which was coming fortuitously, just as I was inaugurated as governor. But I got another call — same man — who said, 'I have some bad news. The company I told you about isn't coming.'" Winter stopped for a moment to let the Roundtable simmer.

"I called up the CEO. I met with him. He said he liked everything about Mississippi — the business climate, the structure, the transportation, the community attitude, the location, the distribution facility. 'But we took a survey at the last minute,' he said, 'and we weren't satisfied that Mississippi had an educational structure that was capable of producing the skilled people we need,'" said Winter.

He paused again, and then added, "I came back to Mississippi. I called a meeting of the heads of the junior colleges and others. I told them that story. Out of that experience, I think we began to develop an understanding of what's involved. We can build four-lane highways, create water and sewer systems, make all kinds of investments. But unless we have an investment in human beings out there that will help them be competitive for jobs that call for increasingly higher skills, we're not going to be competitive."

Most of the day, however, was devoted to discussion that hinged on finding ways to be collaborative, to be cooperative. There was talk of linkages, partnerships, and networks, about how the community college is uniquely positioned and is not an "ivory — or maybe kudzu-covered" institution, as former Governor Scott described other institutions.

Cuyahoga Community College District president Nolen Ellison said this country "is not a neophyte in terms of taking theory and applying it in practical context. . . . We've demonstrated to the world that we can take federal resources and make them state-focused and community-based to move theory to practice in converting human resources to meet economic development needs." About his colleagues in the American Association of Community and Junior Colleges Ellison said, "We're not imbued with the ivory-tower notion that presidents ought not to be out in the trenches building partnerships."

Edwards followed Ellison's remarks with the question, "How do we forge partnerships, not only with industry, but with our major research universities?"

Rivers cited a problem rather than giving an answer. "We can still generate plenty of basic scientific knowledge. However, I think one of the critical problems that we have finally recognized is that the nation has an inability to convert knowledge into technology in the form of goods, products, and services to compete in the world marketplace. Community colleges . . . should position themselves in the applications end of the R&D spectrum."

Rivers' position was seconded by Bill Willis, general manager of the Tennessee Valley Authority. Willis described how TVA worked with local community colleges to help produce a more highly skilled work force by retraining 1700 workers in East Tennessee. He also described a partnership between a community college and General Motors in Alabama to develop a work force that had the basic skills GM wanted. Willis praised community colleges for meeting the challenge of developing higher levels of literacy among workers who need remedial help. "But," Willis said, "we're going to have a look at the whole division of labor between our . . . colleges . . . to see that programs dovetail and support one another. This 2+2+2 thing is a way to get at that. It's going to be a terrific political job to overcome [existing barriers] to do it. But folks, we've got to roll up our sleeves and go to work because the demands have been placed on us, and we've got to get at it."

The models we use across the nation to achieve economic development goals vary widely. Al Lorenzo, president of Macomb Community College, cited three reasons a national policy on ways community, technical, and junior colleges could address economic development needs would be impossible to implement. "First," according to Lorenzo, "community colleges evolve in dramatically different ways across the United States. They see their roles differently, depending on their perception of their mission. Second, each state's economic strategies may be different. Third, the structure of each state government may be different, making the ways in which they deal with colleges different from state to state."

Roundtable participants also discussed the need for balance. Philo Holland stated, "We need balance between our basic educational mission and economic development. If we don't have people who are trained with a solid foundation of skill and understanding, we don't have much of a chance to go further in high-tech kinds of training."

Participants were reluctant to limit the scope of community colleges, yet quick to point out that community, technical, and junior colleges should work to recognize that they are only part of the framework with the capacity to educate. Monty Multanen, immediate past president of the National Association of State Directors of Vocational Education, pointed out that the "network of community colleges within a state can be a tremendous resource for doing things like small business development centers."

Esther Schaeffer added, "We should avoid the tendency to look at the community college system in isolation and not to recognize the whole host of institutions in various communities, be they universities or other training facilities. It's incumbent upon community, technical, and junior college representatives to define their role in relation to whatever else is out there in their community," said Schaeffer.

One of those roles is in job creation, and in creating the right kind of worker to fill those jobs. Jim Adams, president of Southwestern Bell's Texas operation, explained, "When Bill Clements, our current governor, asked me to look at job creation in Texas, we found that we didn't have the infrastructure that would yield trained employees. It's a much sexier topic to talk about employees with graduate degrees, to have a certain atomic scientist that can do this and this and that — or a Nobel laureate. But businesses are looking for people who are trained in biotechnology or lasers — who know how to read and write — who know how to work with people with a business-like mind when they walk from door-to-door fixing telephones."

Scott concurred with Adams, but pointed out that there were some interesting conflicts in what business says it wants. He referred to a series of small conferences held recently in North Carolina with representatives of industries, metal working, agribusiness, chemicals, electronics, and the textile industry. "I asked them to come sit with me and a couple of our senior staff," Scott said. "What we found out was that our CEO's want people who can think and who can make judgments. They said they can teach them skills. And middle management? Middle management wants somebody to do damned well what he's told and not to think! But they agree on one thing; they want us to stay in touch. Otherwise, they said, we'll be out of the ball park and won't be doing them a service," Scott said.

Al Lorenzo cited a similar circumstance Over the last two-and-a-half years, Michigan Bell Telephone Company has conducted 1600 face-to-face discussions with manufacturers in Southeastern Michigan. "Sixty-nine percent of them said they don't require a high school diploma for employment," said Lorenzo. "I guarantee you that those same manufacturers will be angry in five years because their work force isn't retrainable. So I think instead of asking industry for dollars, we should be asking industry to begin requiring successful high school completion so that there's at least some standard," he said.

Ralph Doshier, corporate education manager for Texas Instruments (TI), said, "Technology turnover requires us to do continuous retraining. Our biggest problem right now is finding qualified people, qualified technicians. We can find all the engineers we want." Doshier pointed out that TI requires the Associate of Science degree and that company-sponsored efforts to get the current work force at TI upgraded at local community colleges met with problems. "The issue is how you get a vast pool of people who never even got through high school to have the desire to not only finish high school, but go on to develop marketable skills," he said

DiBiaggio said the problem isn't restricted to Michigan or Texas industries "In my discussions with Lee Iococca, Roger Smith, and Don Peterson — all of whom I know well — we talk about these matters . . . the fact that they're employing someone on the assembly line today who must have certain kinds of analytical capabilities, be able to read intelligently, and who must be able to deal with the technology they face. . . . Too many of our students coming out of high schools do not have those abilities. I tell our students that the most important skills they'll acquire while they're at our institution are the abilities to think clearly, to view and to listen and read intelligently, and to be able to analyze information, synthesize it, and be able to apply it to their lives — because society is so dynamic that this is the only way they're going to be able to survive The fact of the matter is that they do acquire that capacity, no matter what discipline they study," said DiBiaggio, who added that young people are now mature enough to make career decisions while they're in high school, and that our society "has prolonged artificial childhood."

Chet Francke, general director of Joint Education Activities and responsible for joint education programs administered by UAW and General Motors, said that he was "curious about the absence of the word 'student' in any of the questions or any of the material. There's a lot of concern about what our employers are interested in, and it seems to me that ought to be an issue that's not missed when you're talking about the role of an educational institution."

Responding to Francke's concern, Ellison stated, "That's where local college leadership is going to arise," emphasizing that community colleges must keep their role as a service provider to students sacrosanct.

Former Governor Winter shifted the discussion a few degrees by pointing out the unique role and opportunity community, technical, or junior colleges have in a rural setting. Winter, citing the negative economic pressures in rural America, supported the position of author Stuart Rosenfeld that there must be a network of assistance for rural area economic development Winter reiterated his contention several times during the day that a "community, technical, and junior college role in economic development is one of the most essential elements in the preservation of the vital rural economy that, in turn, supports numerous rural communities throughout the nation"

Edward Sanders, manager of government relations and training for the Whirlpool Corporation in Arkansas, joined in the assessment. "In the rural areas, more so than urban areas, I think community colleges must be directly involved in helping their local community. The rural college has a lot of power that can contribute significantly to the overarching community strategy in local economic development The rural community really has an obligation to be a dependable catalytic agent for economic development and growth," he said

Nick Nichols, in his third term as executive vice president of the Communications Workers of America, addressed the question of leadership. "I recently looked at a number of grant requests from various community colleges. Nine out of ten of them deait with setting up new businesses. If you're going to increase students, you're going to have to have something that appeals more to the person who pays the taxes. I think setting up new businesses is great . . but I think you have to be very, very careful that what you do benefits the community and doesn't just make one entrepreneur rich while bringing in only low-wage — very low wage — industries into some places. So what you're doing," said Nichols, "is using tax money to bring in an industry that would get one or two people rien while the rest of the people continued to work at very low wages."

Like Nichols, Bill Willis talked about students, saying what we have now is basically what we get, at least until the year 2000. "It will be the year 2000 before we will see the results of an increase in the birthrate. We have a great task ahead of us to retool this work force, the one we have now. If we're going to be competitive over the next 15 years, we're already in the game. We have to concentrate on that," Willis stated.

Chet Francke concurred. "Retraining your current work force becomes a very critical issue. You can't always go out and hire the skills you want. You have to build them inside. We have 600,000 employees. We have about 50 to 75 thousand who are illiterate, and that's a problem we're concerned about. We're also facing a very serious problem with dislocated workers. We've announced plant closings that will idle about 40,000 employees between now and 1990. . . . The budget for our [retraining] activity is about $200 million a year I think it's about $600 or $700 million annually for the corporation as a whole. . . . The community colleges have been very useful in helping us in our training/retraining efforts Our headquarters is built on the campus of Oakland Community College and several of our other UAW/GM Centers are built on leased community college property. That's the beginning of a close relationship, and it extends to more than just landlord/tenant," Francke explained.

Retraining adults was on every Roundtable participant's mind. In that regard, Monty Multanen said he hopes the concept of 2+2 and 2+2+2 "stays on the front burner as a national focus because it's driving the right kind of people local secondary and postsecondary educators, business persons, government representatives around the table, to end up making more efficient use of resources. I think the students will respond. . . I think any time we can make resources between the elementary, secondary, and postsecondary schools more effient, we're freeing up dollars to take care of what I see as this huge, increasing need for retraining our adult population," Multanen said

Al Lorenzo emphasized the priority to prepare students well. "At the risk of sounding negative, I don't know of another industry in the world that's paid fully for products that don't work — well paid, in fact. K-12 districts can get full-people funding when students go back the second and third time through adult education programs. We in the community college sector don't get full-people funding for the people in our regular programs, so that's an incentive to not make education work the first time," he said.

And so, amidst the demographics and the prophesies, the talk did eventually turn to dollars, with Nichols, Francke, and Doshier agreeing that industry and government must work together to continue to ensure that the dollars for training are there. Because, the way they see it, industry always pays and is willing pay, in one way or another. It is simply a question of making their investment count. It was business and government, after all, who financed the Roundtable discussion. In the twilight of the discussion, Jim Adams of Southwestern Bell, broached the topic of accountability. "I'm convinced that there are two subjects that'll raise a crowd anywhere you go — sex and economic development," quipped Adams. "It's just something that we love to talk about these days . . . The problem is, we end up talking about it, a lot of words. The question is, is something happening? I'm afraid . . we'll end up doing the same thing. It'll be more of a turf issue than it will be dividing and taking a territory, the way we do a war. You do this, another person does that. I think the job of community colleges ought to be job placement, job training . . doing whatever seems to work toward creating a better-equipped work force," said Adams.

In the end, it was more than a day of quoting demographic data, proclaiming prophesies, or worrying about who pays. It was a day of planning, the kind of planning generals do before a war. And, as in war, the education, business, and government leaders sitting around the table on Friday, July 17, 1987, focused on strategies. Now, they say, it's time for all good men and women in community, technical, and junior colleges to marshall local human resources and get down to developing tactics in this forced march toward our nation's economic development.